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SUMMARY OF PROGRESS OF THE GEOLOGICAL SURVEY OF GREAT BRITAIN, 1935—PART I.

Summary of Progress *of the* GEOLOGICAL SURVEY OF GREAT BRITAIN *and the* Museum of Practical Geology for the Year 1935

PART I

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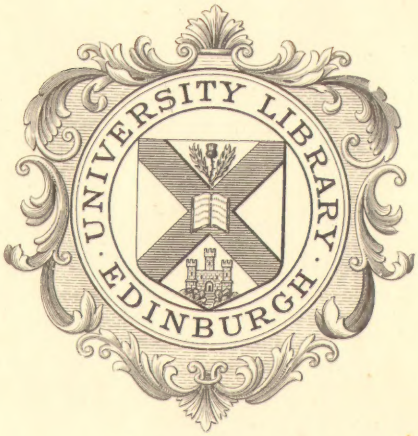

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Department of Scientific and Industrial Research

Summary of Progress

of the

Geological Survey of Great Britain

and the

Museum of Practical Geology

for the Year 1935

PART I

With Report of the
Geological Survey Board and
Report of the Director

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REPORT OF THE GEOLOGICAL SURVEY BOARD FOR 1935

TO THE LORDS OF THE COMMITTEE OF THE PRIVY COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH

MAY IT PLEASE YOUR LORDSHIPS.—

In accordance with our terms of reference, we, the Geological Survey Board, beg leave to submit our Sixteenth Annual Report on the work of the Geological Survey and Museum.

Opening of the New Geological Survey Offices and Museum of Practical Geology Centenary of the Geological Survey

It is with the greatest satisfaction that we record the opening of the new Geological Survey Offices and Museum of Practical Geology and the celebration of the Centenary of the Geological Survey.

The new building was formally opened by H.R.H. the Duke of York on the 3rd July, 1935. The ceremony was attended by a large number of guests and delegates from Great Britain and by delegates from overseas appointed to represent Dominion, Colonial and Foreign Governments, Geological Surveys, Museums, Universities and Scientific Societies at the Centenary Celebrations of the Geological Survey.

On the following day the celebration of the Centenary of the Geological Survey began with an inaugural meeting presided over by Lord Rutherford of Nelson. The celebrations in London were followed by three excursions of one week's duration to classic regions of British Geology, conducted by members of the Survey staff.

Detailed accounts of the Centenary Celebrations and the formal opening of the Museum are given in the Report of the Director (pp. 5—11), which is submitted herewith.

It is most gratifying to be able to record the value of the new Museum as a centre of general and educational interest and the eminent suitability of the building for the purpose for which it was designed. The Museum was opened to the public on the 4th July, 1935, and from that date until the 31st December, it was visited by 158,802 persons. This total is nearly eight times the annual attendance recorded during the last five years in Jermyn Street. Visits by parties from Colleges, Schools and Scientific Societies have been very numerous, and members of the staff have given eighty demonstrations and lectures on the exhibits to such parties. The demand for conducted tours of the Museum is so great that a Guide Lecturer is to be appointed.

Directorship of the Geological Survey and Museum

Sir John Flett retired from the position of Director of the Geological Survey and Museum on the 30th September, 1935. He was succeeded in office by Dr. Bernard Smith.

We cannot allow a distinguished official career to terminate without recording our sense of the value of the services rendered by Sir John Flett to the Geological Survey of Great Britain, particularly during the last fifteen years as Director. Eminent as a petrographer and geologist, Sir John Flett gained distinction alike by his contributions to official publications and by the results of his original researches at home and abroad as presented to various Learned Societies. To his wise and able administration of the Survey during an important period of its history, fittingly concluding with the opening of the new building, the efficient state in which it passes into the hands of his successor is largely due.

Death of Dr. H. H. Thomas

It is with deep regret that we record the death on 12th May, 1935, of Dr. H. H. Thomas, who had been Petrographer to the Geological Survey since 1911.

An appreciation of his work and his personal qualities will be found in the report of the Director. We desire to associate ourselves with that appreciation and to add our own tribute to a distinguished officer of the Survey and Museum.

Field Work

The programme of field work was necessarily curtailed during the first half of the year through the employment of some members of the field staff in preparations for the opening of the Museum and in connexion with the Centenary Celebrations of the Geological Survey.

Field work of almost normal proportions was resumed in July. During the year under review work was carried out in all the areas included in the programme.

The Field Units were engaged in the undermentioned districts:—

Southern District (primary six-inch survey).
West Midlands and Cambridge Districts (primary six-inch survey).
Yorkshire District (revision of six-inch survey).
Lancashire District (revision of six-inch survey).
Forest of Dean (primary six-inch survey).
Northumberland and Durham District (revision of six-inch survey).
Renfrewshire District (revision of six-inch survey).
West Highland District (primary six-inch survey).
Skye (primary six-inch survey).

Reports on the work carried out by each of the Field Units mentioned above will be found in the *Summary of Progress* (pp. 20—22).

Publications

The publication of maps and memoirs has continued.

Twenty-eight six-inch uncoloured sheets of the coalfields under revision have been issued.

Although the progress of publication of the new series of 42 colour-printed six-inch maps of the London District has not been so rapid as was anticipated, eight were issued during the year. The remainder will be issued in 1936.

During the year two economic maps of England and Wales on the International scale of 1 :1,000,000 have been issued. These maps, which illustrate Coalfields and Ironfields respectively, have been prepared with a view to their being of use for teaching purposes or for ready reference.

Considerable progress has been made with the publication of the handbooks descriptive of British Regional Geology, the preparation of which was mentioned in our last Report. For this purpose Great Britain has been divided into eighteen districts. Ten of these handbooks have been issued, and it is expected that the remainder will be published in the ensuing year.

The first complete account of the geology of the Orkneys was published in 1935.

Soil Mapping, Agriculture and Forestry

One geological surveyor continued to serve on the Executive Committee of the Soil Surveyors' Conference of the Ministry of Agriculture and Fisheries and the Department of Agriculture for Scotland. He attended the field meeting of the Conference which was held at Dartington, near Totnes, Devon.

At the request of the Forestry Commission an officer visited part of Laggan Forest, Inverness-shire, with a view to making a geological report to facilitate the study of the forest soils.

The Forest Products Research Laboratory has continued to submit samples of soils for examination and report.

Investigation of Building Stones

The geological surveyor appointed in 1934 to advise on geological problems arising in connexion with the selection of stone suitable for the repair of the stonework of the Houses of Parliament, has visited quarries in Rutland and the Cotswolds.

The Curator has represented the Geological Survey on the Physico-Chemical Committee of the Building Research Board, which has superseded the Standing Chemical and Weathering Committee.

Geological advice has again been given on stones suitable for building purposes.

Fuel Research

Officers of the Geological Survey have continued to serve on the local committees of the Physical and Chemical Survey of the National Coal Resources formed under the Fuel Research Board.

Water

Early in the year Dr. B. Smith, then Assistant to the Director, was appointed an assessor on the Committee set up by the Minister of Health and the Secretary of State for Scotland to advise on an Inland Water Survey for Great Britain. The Geological Survey undertook certain preliminary work in connexion with replies to a questionnaire which has been issued by the Committee, so far as they related to underground water.

One District Geologist continued to give assistance to the River Mersey Committee of the Water Pollution Research Board.

Enquiries by the public on questions of water-supply continue to increase in number.

Certain British Clays have been located and samples forwarded to the Chemical Research Laboratory for treatment as water-softeners.

Conferences

The Assistant to the Director represented the Geological Survey and Museum at the meeting of the British Association in Norwich. Two officers attended the Third International Congress of Soil Science held at Oxford, and took part in the excursions.

Programme for 1936

The programme approved for 1936 is :—

(a) Primary mapping on the six-inch scale in Skye, Inverness-shire, Forest of Dean, Droitwich, Sevenoaks, Bridport and Huntingdon;

(b) Revision of original six-inch mapping in the following coalfields and adjacent areas :—
Northumberland and Durham, Lancashire, Cheshire, Yorkshire, Fifeshire, Midlothian, Renfrewshire and Dumbartonshire;

(c) Investigation of underground water-supplies, examination of mineral resources, verification of bore records, and collaboration with soil-surveys;

(d) Collection of specimens for the Museum and for reference, photographing of geological subjects.

T. Franklin Sibly,
Chairman.

6th April, 1936.

SUMMARY OF PROGRESS OF THE GEOLOGICAL SURVEY AND MUSEUM FOR 1935

I. REPORT OF THE DIRECTOR

THE year 1935 was marked by a joint event of outstanding importance in the history of the Survey—the celebration of its Centenary and the opening of the building that houses the Geological Survey Offices and the new Museum of Practical Geology at South Kensington.

A little over a century ago, Sir Henry De la Beche obtained official sanction " to affix geological colours to the new ordnance maps of Devon and Cornwall." His work, carried out voluntarily and involving a personal survey of over 4,000 square miles of country, led in 1835 to the establishment of the Geological Survey as a recognized State Service. This step, taken on the initiative of the Ordnance Survey, received the wholehearted support of the Fellows of the Geological Society of London, which may thus be said to have been the sponsor of the Geological Survey.

By the end of 1934 it was clear that the arrangement of exhibits in the new Museum at South Kensington had progressed so far that it would be possible to open the building to the public in 1935 and hold the Centenary Celebrations at the same time.[1]

A small Committee was set up by the Department to determine the general procedure to be followed. The date of the opening of the Museum by His Royal Highness the Duke of York was fixed for 3rd July, and a large number of invitations were dispatched to Scientists in Great Britain, the Dominions and Colonies, and abroad.

Opening of the New Museum and Offices

The Museum was opened to the public on 3rd July by H.R.H. the Duke of York, K.G.

The ceremony took place at the eastern end of the Ground Floor, where a dais was erected at the top of the stairs leading from the

[1] A full account of the Survey Centenary Celebrations and the Opening of the Museum will appear in the Memorial Volume, ' The First Hundred Years of the Geological Survey of Great Britain,' written by Sir John Flett, K.B.E., F.R.S. (now in the press).

Entrance Hall and seating accommodation was provided for the invited delegates and guests by removing certain of the exhibits. Over 1,200 guests attended the function. His Royal Highness was received at the front door by the Mayor of the Royal Borough of Kensington and was accompanied to the dais by the Right Honourable W. G. A. Ormsby-Gore, First Commissioner of Works; Lord Rutherford of Nelson, O.M., D.Sc., LL.D., F.R.S., Chairman of the Advisory Council of the Department of Scientific and Industrial Research; Sir Patrick Duff, K.C.B., C.V.O., Secretary of His Majesty's Office of Works; Mr. J. H. Markham, F.R.I.B.A., Architect of the Museum; Sir Frank Smith, K.C.B., C.B.E., F.R.S., Secretary, Department of Scientific and Industrial Research; Sir John Flett, K.B.E., F.R.S., Director of the Geological Survey and Museum; and Dr. W. F. P. McLintock, F.R.S.E., Curator of the Museum.

The First Commissioner of Works delivered the following address:—

"May it please Your Royal Highness, The Building which your Royal Highness is honouring to-day is the new home provided by the Nation for the Geological Survey of Great Britain and the Museum of Practical Geology. The Geological Survey of Great Britain is the oldest national geological survey in the world, and the Centenary of its active existence is about to be celebrated. It was instituted for the purpose of preparing copies of the Ordnance Survey maps geologically coloured so as to be of service to science and industry by providing an accurate representation of the geology of Great Britain. The Museum of Practical Geology developed out of the collection by the Survey of specimens of rocks, minerals, and fossils, and was first opened to the public in 1841. It was soon found that the importance of the collection warranted the erection of a building designed to display the work of the Survey and the application of geology to the arts and industry and, in the year of the Great Exhibition, the building in Jermyn Street was opened by Your Royal Highness's Great Grandfather, Prince Albert.

"It is of interest to note that the site of the new building in which we are now assembled is part of the land which was purchased by the Government from the Royal Commission for the Exhibition of 1851 by whom it was made available, by the inspiration and under the wise guidance of the Prince Consort, for purposes connected with Science and the Arts. During the period of more than eighty years' occupation of the old building, the Museum expanded and became cramped by limitation of space. Towards the end of its life the structural condition of the building deteriorated rapidly, until in 1928 the Royal Commission on National Museums and Galleries described the condition as 'quite deplorable and indeed dangerous'. The new building was commenced in 1929 and was substantially completed in 1933, when it was required for the Monetary and Economic Conference which was held in that year. The cost of the building is some £220,000 and a lease of the Crown Site of the old building has, I understand, been granted at a rent which considerably exceeds the interest on the capital sum expended on the new building. The arrangement of the Museum is in accordance with the best modern Museum practice. The gallery or exhibition space, on three floors, has been treated with simplicity of form and finish in order that the interest of visitors may be concentrated on the exhibits. The maximum intensity of natural light has been secured and special consideration has been given to the provision of the most modern forms of artificial lighting. A top floor will be devoted solely to research by the staff of the Survey and by

students. New offices and laboratories and suitable accommodation for the Library and Map Collection have been provided at the West end of the building for the Geological Survey. The building has been designed by an architect on the staff of H.M. Office of Works and the main elevation expresses in a fitting manner the importance of the Museum, and I think the design is fully worthy of comparison with the other great Museum buildings on neighbouring sites.

I have the honour to thank Your Royal Highness for your presence here to-day and to ask Your Royal Highness to be pleased to declare the building open."

His Royal Highness made the following response :

" Mr. Ormsby-Gore, I thank you for the kind and loyal expressions which you have used in extending to me the welcome of His Majesty's Office of Works on this occasion this afternoon.

" I consider it a great privilege to be here to-day and to accept this fine building from your Department and to dedicate it for the use of the Geological Survey of Great Britain as its future home.

" I congratulate the architect, the contractors, and all concerned in the design and execution of the work. This structure makes a notable and welcome addition to the great and distinguished group of Museums erected on the land provided for the encouragement of Science, Arts, and Industry. With the Science Museum on one side, and the British Museum (Natural History) on the other, it provides a suite of exhibits of Science which cannot be excelled in any other country.

" Two hundred and fifty years ago, in 1683, His Royal Highness The Duke of York opened the old Ashmolean Building at Oxford, which contained, I understand, the first collection of British Geological exhibits.

" One hundred years ago, primarily as a result of the energetic work and advocacy of Sir Henry De la Beche, the Geological Survey of Great Britain was founded, the first official Organisation of its kind. To-day, there are more than 120 official Geological Surveys in different parts of the world, and for many of them, and especially for those in other lands which form part of the British Commonwealth of Nations, the Geological Survey of Great Britain has been a pattern. I am glad to know that amongst those here present are many who have come to this country from abroad to celebrate the Centenary of the Survey and to pay tribute to its work.

" In the minds of all British and many Foreign Geologists, the Geological Survey of Great Britain is inseparably associated with the old Museum of Practical Geology in Jermyn Street. For eighty-five years that building was a great and famous centre of Geological Science in which Geologists, Mining Engineers, and Metallurgists, pursued the studies which enabled them later on to contribute to the development of the mineral resources of every part of the world. From to-day, the Geological world will think of the Survey in association with this fine new building, which cannot fail to give new inspiration to all who work and study in it.

" This Museum, with the Geological Survey, serves many purposes. The work of the Survey has provided, and is providing, year by year, a mass of knowledge indispensable to the welfare of the great Mining interests of our country, to Agriculture, to Public Health and Town Planning, and to a great variety of industries on which our economic prosperity depends. In this building the results of that work are recorded and displayed in a wealth of specimens drawn from the whole country. The Museum supplies valuable facilities for the student and research worker in Geology; and last, but by no means least, as I look around me I can see that it will not fail to capture the interest and engage the intellectual attention of the layman, and to demonstrate to him that Geology is a living Science which touches at many points the everyday life of himself and his fellow Citizens.

" I congratulate the Curator and Staff of the Museum on the success with which they have accomplished the difficult task of transferring from Jermyn Street the vast number of individual exhibits.

" In this new building, the Geological Survey of Great Britain will have an opportunity of continuing and enlarging its public services. I know that it will justify the encouragement which it has received, and I wish it a full measure of success in the future.

" It gives me great pleasure to declare the Museum open."

The following representatives of the contractors and the staff of H.M. Office of Works concerned with the construction and equipment of the building were then presented to His Royal Highness by the First Commissioner of Works:—Mr. John S. Galbraith (Managing Director, Messrs. Galbraith Brothers, Ltd.); Mr. Arnold Statham (Managing Director, Messrs. Banister, Walton & Co., Ltd.); Mr. E. Harrison (General Foreman); Mr. William Wharram (Ganger); Mr. N. Sizer, M.C., A.M.I.E.E. (Assistant Engineer, H.M. Office of Works); Mr. Ralph S. C. Ball (Director, Messrs. Read and Partners, Ltd.); Mr. Charles E. W. Buck (Assistant Technical Officer, H.M. Office of Works); Mr. Charles C. Regnart (Director, Messrs. Maple and Co., Ltd.).

This was followed by the presentation by Lord Rutherford of the following members of the Geological Survey Board:—Mr. T. Franklin Sibly, D.Sc., LL.D. (Chairman), Professor C. G. Cullis, D.Sc., Sir Thomas H. Holland, K.C.S.I., K.C.I.E., D.Sc., LL.D., F.R.S., Sir Edwin H. Pascoe, Sc.D., D.Sc., Mr. J. Romanes, M.A., Professor A. C. Seward, Sc., LL.D., F.R.S., and of Mr. W. H. Worgan (General Foreman of the Museum).

Thereafter His Royal Highness made a brief inspection of the Main Floor and the First Gallery of the Museum and was pleased to express his favourable opinion of the exhibits and their arrangement.

Tea was served to the guests in the Library, the Demonstration Room, the Board Room, and the First Gallery, and the Museum closed at 6 p.m.

On the following day the Museum was opened to the public, the normal open hours, namely, weekdays 10 a.m.—6 p.m., Sundays 2 p.m.—6 p.m., being observed.

Centenary Celebrations of the Geological Survey

During the evening of July 3rd the Geological Society of London held a reception of delegates and guests in its rooms, and those of the Royal Society at Burlington House, Piccadilly. The company was received by the President, Mr. J. F. N. Green, and an extensive series of geological and cognate exhibits was studied with interest.

On the following day, 4th July, the Centenary of the Survey was celebrated at a formal meeting held in the Lecture Theatre of

the Royal Geographical Society, Kensington Gore. Lord Rutherford, O.M., D.Sc., LL.D., F.R.S., Chairman of the Advisory Council of the Department of Scientific and Industrial Research, presided, and with him on the platform were Sir Frank Smith, K.C.B., C.B.E., Sec. R.S., Secretary of the Department; Dr. T. F. Sibly, LL.D., Chairman of the Geological Survey Board; Sir John Smith Flett, K.B.E., LL.D., F.R.S., Director of the Geological Survey and Museum; Professor (Emeritus) W. W. Watts, Sc.D., F.R.S., President of the British Association for the Advancement of Science; Professor Coleman, Toronto; Professor Matthews, Baltimore, U.S.A.; Professor de Margerie, Paris, and Dr. von Seidlitz, Director of the Geological Survey of Prussia.

Lord Rutherford referred to the interest and importance of the occasion and emphasized the great services which the Geological Survey of Great Britain had rendered to geological science and to the furtherance of the industries of Great Britain. He pointed out that the large and representative gathering of scientists assembled from all parts of the world indicated in striking manner the widespread respect and admiration with which the British Survey was regarded.

After the delegates and overseas guests had been presented to the Chairman by Sir John Flett, the latter gave a short address on the history and functions of the Survey.[1]

"After outlining the circumstances which attended the foundation of the Geological Survey and the history of its early years under De la Beche he passed in review the successive stages of its development under Murchison, Ramsay and Geikie. The Geological Survey was one of four institutions that were conceived in the fertile brain of De la Beche, the others being the School of Mines, the Mineral Statistics Bureau and the Museum of Practical Geology. They had all survived and prospered, the Royal School of Mines being now associated with the Imperial College of Science and Technology in a splendid building adjacent to the new Museum of Practical Geology, while the Mineral Statistics were taken over by the Mines Department and the Imperial Institute. The Museum in Jermyn Street long famous as a centre of scientific research and training had now been replaced by a more commodious building. The Geological Survey continued, much expanded and improved, but still in large measure working on the lines laid down by De la Beche and had served as a model which other countries had wisely imitated. Since 1900 new energy had been imparted by the policy adopted by Teall and by his successor Strahan, and the institution had never been more active, more competent and more progressive than at the present day. Every department of geological investigation was represented on the staff and in its publications, which had a world-wide distribution and were representative of the best standard of British scientific research. Apart from its maps and memoirs, which were indispensable guides for many departments of British industry, the Survey had made notable contributions to the solution of problems of water-supply, building, engineering, drainage, town planning and agriculture. As a national service it had received much encouragement and support both from the authorities and from the public, and could hopefully look

[1] From 'The First Hundred Years of the Geological Survey of Great Britain' (in the press).

forward to another century of useful work and scientific discovery, assured that, in serving the public and in contributing to the advance of science, it would receive the recognition that it deserved."

The Chairman then asked the representative delegates, seated upon the platform, to reply. The following are a few only of the points touched upon by the speakers.

Professor Coleman stressed the many sides of geology that are represented in the rocky structure of Great Britain, and pointed out that the work of British geologists had been so successful and so important that one naturally expected to find the Survey and its Collections housed in splendid quarters befitting its achievements.

Professor Matthews congratulated the organisation on the way in which the wisdom of combining three essential functions had been clearly seen and acted upon—namely, development of natural resources, contributions to the growth of Science, and dissemination of the results of studies for the enrichment and edification of the public. By the even-handed manner in which this had been done the Survey had been a guide and example to all the Geological Surveys of the world.

Professor de Margerie referred to mutual help and personal contacts established between British and Continental geologists, and stated that it was only after Élie de Beaumont and Dufrénoy had spent a few seasons in England to see how the British surveyors were operating on the ground, that the preparation of a geological map of France and its publication at the cost of the state was decided on. The British Survey was the direct ancestor and prototype of every other Geological Survey now operating on the surface of the globe.

Dr. von Seidlitz, speaking on behalf of German Surveys and Geologists referred to the great progress made in Science in the last hundred years, and to mutual friendship and help in scientific work. English geologists, he remarked, took the lead early last century in putting theory into practice. The reputation of the leading men of the Geological Society of London and of the Geological Survey reached far beyond the limits of their own country. He touched upon the work of past Directors, and the various bonds of union that have been cultivated by the geologists of England and Germany. "It is of the nature of geological research that it crosses the boundaries of states and countries, forging links between them."

The appreciative remarks of Professor Watts were especially welcome, coming from one who previously had personal connexion with both the Survey and the Royal School of Mines, and who had served as a member of the Geological Survey Board. Referring to the removal from Jermyn Street to South Kensington, he remarked that to none of the great Scientific Institutions established there is the revived proximity more cordially welcomed than by the Imperial College.

After the meeting a group photograph was taken at the north-east corner of the Museum.

The afternoon was spent by most of the guests in visits to the Geological and neighbouring museums, or in preliminary discussions with excursion leaders.

In the evening the delegates from overseas were entertained by the members of the Geological Society Dining Club and the staff of the Geological Survey at dinner in the Rembrandt Hotel, Brompton Road, South Kensington. Sir John Flett presided over a gathering numbering more than two hundred, and proposed the toast of "Our Guests," which was responded to by Dr. Alfred Day, Director of the Geophysical Institute of the Carnegie Institute of Washington and Vice-President of the Washington Academy of Sciences. Later in the evening the company attended a reception given by H.M. Government in Lancaster House, where about 1,000 guests were received by the Right Honourable W. Ormsby-Gore, First Commissioner of Works, and the Lady Beatrice Ormsby-Gore.

On the day following the termination of the Celebrations a start was made with the programme of three of four[1] excursions that had been arranged to visit classic regions of British geology. These lasted for a week and were led by Survey geologists who were familiar with the chosen districts. Owing to difficulties in finding accommodation and in providing transport the numbers attending each excursion were limited to thirty. An itinerary and short guide to the geology of each district was printed and circulated in advance. The districts were:—(1) The Isle of Wight and Adjacent Mainland: Leaders, Messrs. C. P. Chatwin and F. W. Anderson; (2) South Wales and Bristol: Leaders, Dr. J. Pringle and Mr. E. E. L. Dixon, and (3) Edinburgh: Leaders, Dr. J. E. Richey and Mr. A. G. MacGregor. At the Centenary Meeting these were referred to by Professor W. W. Watts as follows: "The Isle of Wight, a pocket edition of later British Geology, revealed by the work of Forbes and Bristow, of Strahan and Reid, and recalling Lyell's long-standing classification of the Tertiary Rocks: South Wales and Bristol, recalling the labours of Logan and Ramsay, Strahan and Thomas, and of Marr, Roberts, Hicks, and Arthur Vaughan: and Edinburgh, rendered classical by Hutton and Playfair and their worthy followers, Peach, Horne, Clough and the Geikies."

The excursionists, about half of whom were delegates from overseas, were favoured by beautiful weather, and upon their return expressed the liveliest satisfaction in the leadership and in the selection of localities and subjects for exposition.

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[1] The projected excursion to the Weald did not take place.

Progress of the Geological Survey 1920-1935

There is little doubt that the transference of the Geological Survey and Museum of Practical Geology from the Board of Education to the Department of Scientific and Industrial Research in November 1919 and the celebration of the Centenary of the Survey with the opening of the new Museum in 1935, will be considered in future as landmarks in the course of the Survey's progress. The intervening period coincides closely with the term of Sir John Flett's Directorship, and we may perhaps with advantage seize this opportunity to review the progress that has been made during the years of recovery since the War. The full story will be told by Sir John Flett himself in the Memorial Volume on "The First Hundred Years of the Geological Survey of Great Britain," which will be issued in 1936.

In 1920 there were still many arrears to be overtaken in field work and memoir writing that had accumulated during the War, and the staff were busily engaged in resuming their normal activities.

Much of the economic information that had been gathered on the initiative of Sir Aubrey Strahan during the War and just after its termination was considered of sufficient importance for publication. By the end of 1918 seven volumes of the series of 'Special Reports on the Mineral Resources of Great Britain' had appeared and in 1919 three more were issued. The series was continued by the new Director until no less than 31 volumes, some of which have appeared in two or three revised editions, have now been published. Although in condensed form, the information in these books is of a high standard of reliability and has proved to be of lasting value, since it was mainly obtained by personal visits to working mines and quarries by experienced field-geologists.

The Geological Sub-Committee of the Coal Conservation Committee (1918), in presenting their report on the work of the Geological Survey in relation to the Coalfields, had pointed out, with some emphasis, that the maps of the majority of the British Coalfields were in an unsatisfactory state. In some cases there were no six-inch maps available, and in many of the most important coalfields the primary six-inch maps were about 50 years old and had never been revised. It should be remarked, however, that the Survey had done all that was possible with the staff available. The South Wales Coalfield, the Nottinghamshire and Derbyshire and North Staffordshire coalfields, had been recently mapped as a primary six-inch survey, and revision of six-inch work was in progress in the Midlands and in Scotland. The pace, however, was not considered satisfactory and it was recommended that the primary six-inch survey of all coalfields and their possibly concealed parts should be completed, and that coalfields previously

surveyed on the six-inch scale but not revised during the last 30 years should be revised at as early a date as possible.

To carry out the recommendations of the Committee a considerable increase in staff was required. In 1920 eight new geologists were appointed, and four more were added in 1922. Extra Technical Assistants were also engaged. Four Provincial Offices in the coalfields were opened, each staffed by a District Geologist, three or four Geologists and a Draughtsman. The arrears left over from the war years were cleared off as rapidly as possible (in England and Wales, for example, the maps and memoirs of the Flint and Denbighshire coalfields were completed)

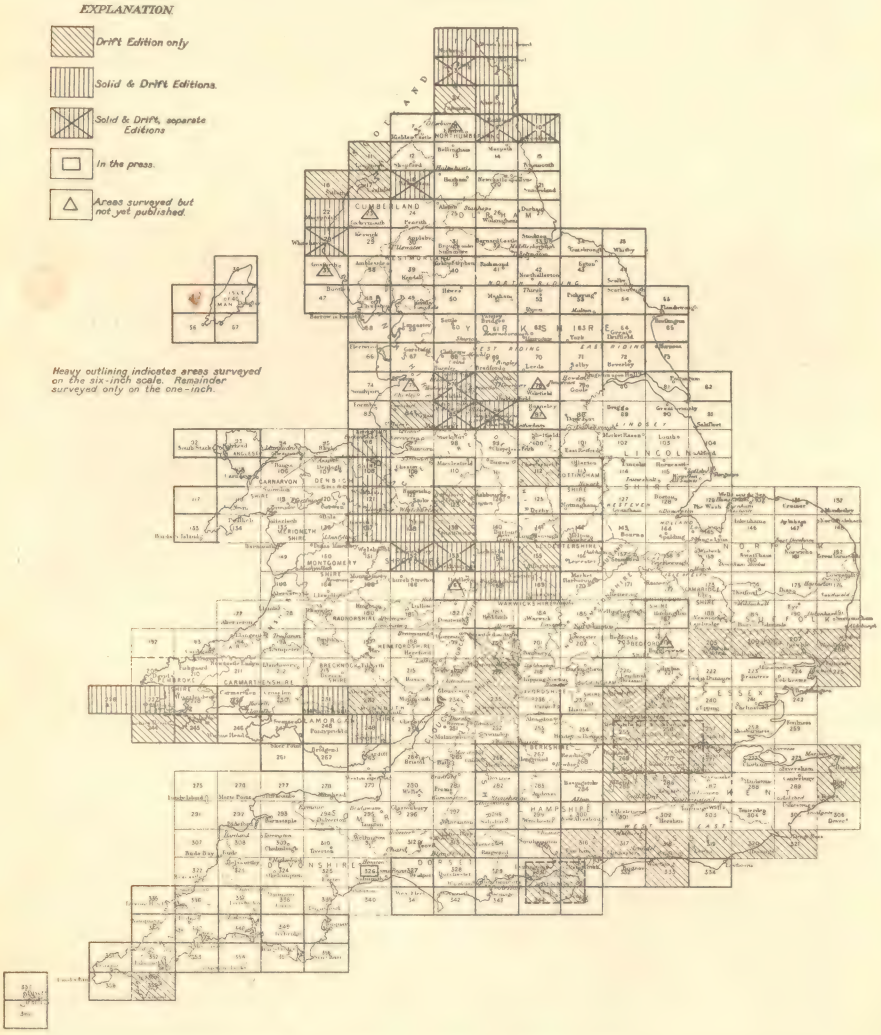

EXPLANATION
Drift Edition only
Solid & Drift Editions.
Solid & Drift, separate Editions
In the press.
Areas surveyed but not yet published.
Heavy outlining indicates areas surveyed on the six-inch scale. Remainder surveyed only on the one-inch.

FIG. 1—*Publication of One-inch Maps, England and Wales,* 1920-35.

and the new field campaign was entered upon with zest. A glance at the Index Map, Fig. 1, will show that by 1935 the Cumberland Coal and Ironstone fields had been re-surveyed as well as the greater portions of the Lancashire and Cheshire Coalfield and also that of Yorkshire. Most of the coal-bearing Limestone Measures of Northumberland and East Cumberland have been revised and the work is now being carried southwards into Durham.

An important publication in 1926 was the second edition of the Concealed Coalfield of Yorkshire and Nottinghamshire, which first appeared in 1913 with Dr. Walcot Gibson as the author.

The last of the coalfields of the West Midlands—that of the Forest of Wyre—is now receiving revision, or rather re-survey, for that in effect is what is involved in most cases of revision after so long an interval. Revision, rather than re-survey, has been possible in the case of the six-inch sheets of the Merthyr and Abergavenny districts, re-issued between 1927 and 1932, many of the six-inch maps having been made about 20 years previously. A recommendation of the sub-committee of the Coal Commission that there should be a decennial revision of the six-inch geological maps of all areas where coal mining is in progress has unfortunately never been possible of fulfilment. The primary six-inch survey of the Forest of Dean Coalfield is in hand, and there remains now only the Bristol and Somerset Coalfield of which there has been no six-inch survey. The latest one-inch maps (Old Series 19 and 35) were published in 1872-3, but some additions were made to Sheet 19 in 1899. A description of the Concealed Kent Coalfield appeared in the *Summary of Progress* for 1932, Part II.

Meanwhile, it will be noted, as examples, that of the six-inch maps of the South Wales Coalfield originally published between 1905 and 1909, a large number are 30 years old, and of these a few only have been revised. A number of the Nottinghamshire and Derbyshire six-inch maps date from 1910 or earlier; some of those of Leicestershire from 1905, and of Staffordshire (*e.g.* North Staffordshire and Cheadle Coalfield) from 1903. The need for revision of these may become urgent before long.

In Scotland, also, efforts were largely concentrated on coalfield revision, and so that it should be accelerated work was discontinued in the Highlands for several years and not resumed until 1926. A great advance has thus been made, since the first revision which was begun in 1902 is now practically completed and most of the maps and memoirs are published.

With the urgent necessity for coalfield revision in England, other areas, which have awaited attention for many years, were perforce neglected. Up-to-date six-inch maps of those areas previously surveyed only on the one-inch scale and published in many cases on an obsolete type of topographic map, are badly wanted by those who represent a variety of interests other than mining and pure geology—such as civil and water engineers,

industrialists, consultants to Urban and Rural District Councils, estate agents, agriculturists and archaeologists. One unit, however, was kept at work in the London District and the South of England. A re-survey of the Thames Valley from Reading to Sevenoaks was completed and extended into the northern part of the Weald; and a re-survey of the Torquay, Bridport and Lizard Sheets has been secured. In 1933 the issue of a series of six-inch colour-printed maps of the London District was commenced. These are the first six-inch colour-printed geological maps to appear.

A block of four one-inch Sheets centred on Cambridge is now being re-surveyed on the six-inch scale, and with the help of outside experts revision of such one-inch sheets as the Isle of Wight, Moreton-in-the-Marsh, Brighton, Cirencester, Ipswich and others, has been made and accompanying memoirs written. The published maps, however, in many cases are not based on a full six-inch survey. The revised memoir describing the special Oxford sheet was produced in time for the Oxford Meeting of the British Association in 1926. In addition to these activities a number of old hand-coloured one-inch sheets have been re-issued, in some cases with slight revision, as colour-printed sheets.

Besides coalfield work in Scotland important and original work has been done in the Highlands and in the Orkneys and Shetlands. The mapping of the Mull and Ardnamurchan volcanic centres was completed and the novel and interesting geological structures described. An account of the geology of Arran was written by Dr. Tyrrell of Glasgow University for the Survey, incorporating the earlier account of the northern half of the Island contributed by W. Gunn to the Explanation of Sheet 21 (1903). These investigations have led to a notable advance in our knowledge of some of the most striking episodes in the geological history of Britain. Geological models of the two first-named of these volcanic districts are now on exhibition in the Museum.

An interesting event was the publication of colour-printed one inch to the mile soil maps of North and Central Ayrshire (Sheets 22 and 14). These Sheets have thus appeared in three editions—Solid, Drift and Soil Texture.

The Index Map, Fig. 1, shows the progress in publication of English and Welsh one-inch maps between 1920 and 1935. Those shaded with ruled lines are colour-printed and all are second or later editions of one-inch maps previously published hand-coloured. The sheets with heavy outlines are based on an original six-inch survey or, as in the northern coalfields and occasionally elsewhere, on a six-inch modern revision or re-survey. It will be noted that a number of the maps issued in the period are colour-printed editions of old one-inch maps previously hand-coloured. In issuing such maps in colour-printed form opportunity has been taken in some cases to give the sheets a partial revision.

The original six-inch survey of the North of England is almost complete, but there are gaps here and there where no

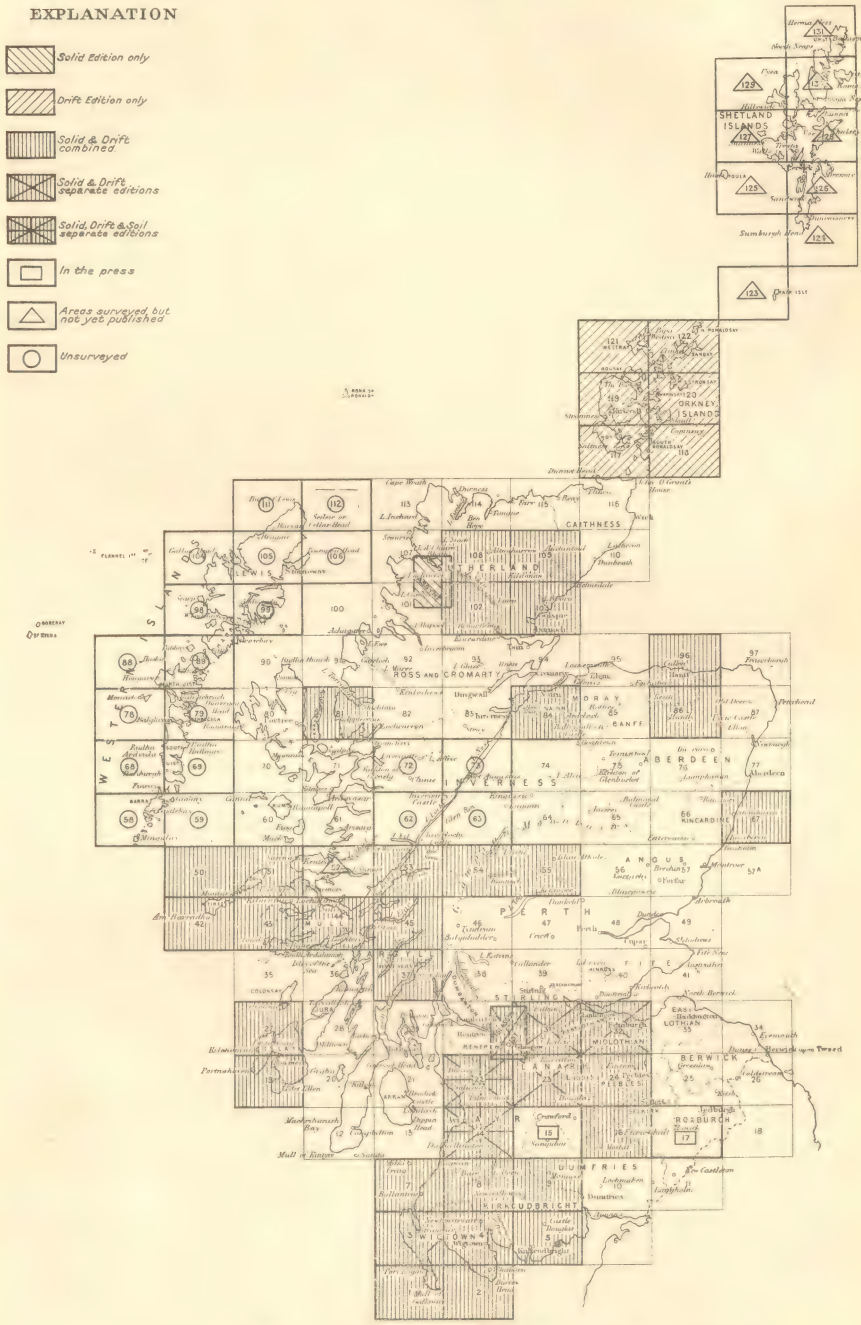


FIG. 2—*Publication of One-inch Map, Scotland,* 1920-35.

six-inch mapping has been done. One point brought out very clearly is the great area of England and Wales—more especially in the Eastern Counties, in a belt from Devonshire to the Wash, and in Wales—of which only a one-inch pioneer survey is extant. The want of large-scale maps of these districts showing the solid geology, and also of others showing the distribution, thickness and character of the drift deposits overlying the solid rocks, is much felt by a host of enquirers and users of such maps. It is desirable that the omission should be made good as opportunity offers. Survey is in progress in Sheets 7, 13, 14, 15, 20, 69, 97, 182, 187, 233, 236, 287 and 327.

The Index Map, Fig. 2, shows the progress of publication of Scottish one-inch maps between 1920 and 1935 inclusive. All sheets shaded with ruled lines are colour-printed, but all are not first issues of the one-inch map, since a number are second or even later editions of maps previously issued hand-coloured. Sheets 42 and 50, 43, 44, 51, 53, 54, 84, 86, 102, 108 and 109, the Orkneys, 117—122, and the Assynt District Sheet are first editions of these sheets, whilst the remainder issued during this period are mostly second editions with more or less revision.

Besides showing areas surveyed but not yet published, and colour-printed sheets now in the press, Fig. 2 indicates those areas of Scotland *that have never been surveyed officially on any scale.* The numbers of the sheets in question are ringed around. Sheet 52, the survey of which has just been completed, represented one such area, and Sheets 61, 80 and 90, now under survey, represent others. All other parts of Scotland have been surveyed on the six-inch scale, and all the Scottish maps not accounted for in the above brief summary are published in one-inch form, some as colour-printed maps issued before 1920. A revised survey is in progress in Sheets 30, 39, 40 and 41.

The following table summarizes the output of maps, memoirs, etc., between 1920 and the latter part of 1935.

	England and Wales	Scotland	Total
Published One-inch Sheets (S. & D.) ...	98	51	149
,, ½-inch Sheets ,, ...	19	5	24
,, Six-inch Quarter Sheets (S. & D.)	550	283	833
Library copies of ditto	1,320	440	1,760
Economic Maps	2	—	2
Sheets, Vertical Sections	9	14	23
General Memoirs and Special Reports ...	25	3	28
Economic Memoirs (Scottish Coalfields) ...	—	15	15
District Memoirs and Regional Geology ...	13	11	24
Sheet Memoirs	49	9	58
Summary of Progress (Pts. I—III) ...	26	26	26
Water Supply Memoirs	12	—	12
Museum Guides, Monographs and Miscell.	15	—	15
Area surveyed (square miles)	7,390	3,800	11,190

The area surveyed accounts only for the systematic surface survey: it does not take into consideration underground surveys or work on mining plans, nor does it include work done in connexion with water-supply, certain economic surveys and minor revisions of maps in the field.

Before 1920 reports on road stones had been made as required to the National Physical Laboratory. After the Survey came under the Department of Scientific and Industrial Research this work was continued, and new contracts were made with other organizations under the Department. In 1921 the Survey commenced to co-operate with the Fuel Research Board. A Survey Officer serves on each local Committee of the Physical and Chemical Survey of the National Coal Resources set up in various coalfields and helps to bring the available geological information into relation with the physical and chemical investigations being carried out by the Board. The Geological Survey also has more or less permanent connexions with the Building Research Station, the Water Pollution Research Board, the Forest Products Research Laboratory and the Chemical Research Laboratory. Outside the Department assistance is given to other State services, such as the Ministry of Health.

Collaboration has been secured between the geological surveyors, soil surveyors and agriculturists. Field meetings arranged by the Soils Correlation Committee, set up by the Ministry of Agriculture and Fisheries in conjunction with the Department of Agriculture for Scotland, have been attended regularly by geologists who render all help possible in arriving at suitable classifications of soils on the basis of the parent material. This Committee made recommendations to the Soil Survey Conference which, in 1934, was superseded by the Soil Surveyors' Conference, with a standing Executive Committee, the latter replacing the Soils Correlation Committee. A member of the Survey staff serves on the Executive Committee.

Survey activities were increased in 1926 when, under the Mining Industry Act of that year, provision was made that all shafts and borings for minerals intended to reach over 100 ft. in depth should be notified, so that a complete record and examination of the strata penetrated might be secured. This notification also applies to borings for oil.

By the enlargement of the duties of the Survey in the post-War years, by the wider knowledge of its activities, by the opening of district offices, and in other less obvious ways, the number of enquiries of all kinds received from the general public for answer has increased greatly and progressively during the period under review, and has been swollen of late by demands for geological information in connexion with underground water supply.

Staff Changes, 1935

Sir John Flett retired from the Directorship at the end of September.

Dr. Bernard Smith (Assistant Director for England) was appointed Director, and Mr. H. Dewey, District Geologist (Southern England) became Assistant Director in Dr. Smith's place.

By the sudden death of Dr. H. H. Thomas, F.R.S., on 12th May, the Survey suffered a great loss. Dr. Thomas had served as Petrographer to the Geological Survey since 1911, when he succeeded Sir John Flett, who had been appointed Assistant Director in Scotland. His distinguished services to British petrography was widely recognized, and he had been awarded the Murchison Medal by the Geological Society of London. He was also a Member of Council of the Royal Society. He was author of, or contributor to, many important geological papers and memoirs and took a considerable share in the striking advances that have been made in recent times in our knowledge of the Tertiary Central Volcanoes of Scotland and their associated igneous rocks. His knowledge was extensive and his personality so engaging that his advice and help were sought by a wide circle of enquirers whose interests were in geology, mineralogy and archaeology.

The vacancy created by Dr. Thomas' death was filled by the promotion of Dr. J. Phemister, who as field-geologist and a petrologist was previously a member of the Scottish branch of the Survey.

Mr. Bromehead, District Geologist in York, was transferred to London to fill Mr. Dewey's place, and Mr. T. H. Whitehead was promoted to District Geologist in charge of the York Office.

In July Mr. V. A. Eyles was transferred from the Northumberland unit to Edinburgh and took part in field work in Renfrewshire under Dr. Richey.

Outstanding vacancies and two new posts as geologists on the Survey and Museum Staff were filled by the appointment of Mr. F. W. Anderson in January, and of Messrs. A. J. Butler, J. A. Robbie, J. H. Taylor, and Dr. K. C. Dunham in October. The two new posts were created in order to provide the Curator with much needed assistance in dealing with the collections and Museum display. Mr. Davidson and Mr. Butler have taken over these duties.

Mr. F. W. Anderson was transferred to the Edinburgh Office in August to take charge of the palaeontological collections under Dr. J. Pringle. In October Mr. K. P. Oakley resigned to take up an appointment in the Geological Department of the British Museum (Natural History), and the vacancy was filled by the appointment of Mr. S. C. A. Holmes in December.

Mr. S. W. Morgan, who since 1897 had been an Assistant in the Palaeontological Department where he had given every satisfaction in the performance of his duties, retired on 30th June after completing his service.

The number of warders, carpenters and labourers was increased to cope with the extra work entailed by the opening of the Museum and the maintenance of activities.

Mr. L. White, of the Museum Staff, was transferred to Headquarters in March.

Field Work

The programme of field work was necessarily curtailed through the employment of a number of the field staff in preparing exhibits in the Museum and in arranging and conducting field excursions in connexion with the Centenary Celebrations. In the latter part of the year, however, a resumption of field work of normal proportions was possible in most of the districts, although some of the staff were still engaged in Museum work or in writing up their allotted shares of the handbooks on British Regional Geology. In all some 20 men were employed in this way for various periods in the early part of the year. Of those who had been entirely occupied in this work in London Dr. W. Q. Kennedy of the Scottish staff and Mr. V. A. Eyles of the Northumberland unit were released in July, and Mr. Dines in May. Mr. Davidson is now permanently engaged in Museum work, and Mr. Oakley was similarly employed until his retirement. Mr. Edmunds, on completing Museum work wrote the handbook on the Regional Geology of Central England in collaboration with Mr. Oakley, and has since commenced work for the Inland Water Survey Committee.

England and Wales.—In England the Biggleswade Sheet (204) was completed last year and work has been carried northward by Mr. Dixon and Dr. Sherlock into the Huntingdon Sheet (187), one of the four maps covering the area of which Cambridge is the centre. This sheet was surveyed on the six-inch scale in 1893, and published with a revision of the Corallian rocks in 1900. The geology is fairly simple, being mostly Jurassic clays and surface drifts, and good progress is being made with the re-survey.

In the Droitwich district (Sheet 182) progress was made in the primary six-inch survey by Drs. Pocock and Hollingworth. The simpler part of this Sheet, consisting chiefly of Triassic rocks, has now been nearly completed, leaving much of the more difficult western portion, comprising the southern end of the Forest of Wyre Coalfield and the northern part of the more complex Abberley Hills, still outstanding. After a period of field training with Dr. Hollingworth, Mr. Taylor mapped a small tract of ground.

Some work was done by Dr. Buchan in the Sevenoaks or Tonbridge Sheet (287), but much of his time was taken up in the

preparation and checking of the six-inch colour-printed maps of the London district, and in other indoor duties. He also made visits to the field to examine temporary exposures, and lay down the courses of some of London's ' Buried Rivers '.

Mr. Dines has made a primary survey of drifts in the Witney Sheet (236) on the six-inch scale and checked or mapped certain boundaries in the solid rocks in order to facilitate accurate reproduction on the New Series contoured map of the lines on the old hachured map. That ground is partly covered by the special Oxford Sheet, of which a complete six-inch survey has been made. The one-inch map is to be published colour-printed and the memoir is being written by Mr. Linsdall Richardson. On its western side, the area is contiguous to that covered by the new Cirencester Sheet (235), which was described by the same author.

Dr. Welch has been active in the Bridport and Charmouth district (Sheet 327) and the primary six-inch mapping is now well advanced. During the autumn Mr. Robbie was put through a course of field training by Dr. Welch, whom he assisted at a later stage in surveying some of the richly fossiliferous Liassic coast sections between St. Gabriel's Mount and West Bay.

In Monmouthshire (Sheet 233) Mr. Eastwood's staff resumed their work on the primary six-inch survey of the Forest of Dean Coalfield and its outskirts. Owing to the dense undergrowth, the coalfield itself can only be examined with facility during short periods of the year. Dr. Dunham joined this unit in October. In the Cockermouth district (Sheet 23) outstanding difficulties in the interpretation of the structure and sequence in the Skiddaw Slates were cleared up as far as possible in the field, and the six-inch maps are now almost completed.

Field work in the Bradford-Skipton district (Sheet 69), in extension of last year's work in the Lower Carboniferous Skipton Anticline, was continued by Dr. Mitchell, and fresh ground was broken by Messrs. Edwards and Stephens, who have completed their work in the Wakefield (78) and Barnsley (87) Sheets. The Bradford Sheet covers the north-western limits of the great Yorkshire Coalfield, which is margined by Millstone Grit Moorlands near Keighley, Ilkley and Otley.

In the Northumberland district Mr. Carruthers' staff carried on work in two areas, the first being one of Lower Carboniferous rocks near the Scottish Border, where the revision of Sheet 7 was nearly finished, and the second lying north-west of Newcastle (Sheet 14) on rocks beneath the Coal Measures. The re-survey of the Northumberland Coalfield being now well in hand, that of Durham was again taken up by Mr. W. Anderson, south of Gateshead and Roland's Gill (Sheet 20), as an extension of a survey made by him in 1923, of which four six-inch sheets have been published. Several years' work lies ahead of this unit before the revision of the whole coalfield can be completed.

A small area necessary to complete the re-survey of the Preston Sheet (75), Lancashire, was examined by Mr. L. H. Tonks. Dr. Wright and his staff then transferred their attention to the Runcorn district (Sheet 97). This embodies a part of the exposed Lancashire Coalfield and its concealed extension around Prescot, south of St. Helens, but over the greater part of the area the cover of Triassic rocks is thick. Much of the ground is obscured by drift and rapid progress should be made with the survey.

Scotland.—In Scotland, after a lapse of some years, the six-inch revision of one-inch Sheet 30 was resumed in Renfrewshire. In the late summer a considerable part of the Calciferous Sandstone lava-plateau south of the Clyde Estuary was re-mapped by Dr. Kennedy and Mr. Eyles.

Dr. Richey and his staff carried out a short field programme on the primary survey of the Highlands in the Arisaig-Mallaig district (Sheet 61). Amongst other results of interest a stratigraphical sequence has been established in the most westerly known schists of the Moine Series. Tertiary dykes mapped in the Morar area complete the evidence for the existence of a north-south suite of dykes, which connects the Skye and Mull plutonic centres.

The primary survey of Northern Skye was continued by Mr. Wilson and his staff. In this district Jurassic sediments with intrusive sheets of dolerite are overlain by Tertiary lavas and sediments, the whole being cut by a varied series of dykes. The Tertiary sediments include thin layers of coal such as have been long known to occur at about the same horizon in other parts of the island and in the Ross of Mull. On the eastern side of Trotternish a great inland landslip—probably the largest recorded example of such a phenomenon in the British Isles—has been traced from north to south for a distance of over 15 miles.

Publications

Maps

England and Wales.—Two sheets of the revised issue of the colour-printed quarter-inch map of England and Wales have been published during the year, and four sheets are in the press and will be issued in 1936. There still remain three sheets (3, 4 and 5 with 6) in the north of England to complete the issue of ' solid ' editions. These will be prepared and sent to the engraver as time permits. Owing to the sporadic manner in which the drifts of parts of England and Wales have been surveyed, it is at present only possible to print ' drift ' as well as ' solid ' editions to cover the eastern part of England from Flamborough Head southwards.

These quarter-inch maps meet a popular demand, since they cover large areas, and are thus suitable for use on district excur-

sions and motor tours, as well as for teaching purposes. They are ideal complements to the new Survey handbooks on British Regional Geology. Opportunity has been taken during the revision to incorporate in the maps as much as possible of new survey work, and important published work of other geologists. In many cases, however, discontinuity in mapping militates against doing this successfully.

During the year two Economic Maps of England and Wales have been issued on the scale of 1 :1,000,000, or 15.79 miles to the inch. This is an International scale, as adopted by the Ordnance Survey for their Hill-shaded, Physical and Historical Period Maps. The economic maps are expected to be useful for teaching purposes and also as the bases of reports and in reply to economic enquiries. The frame of each map, as adapted for our purpose by the Ordnance Survey, excludes Ireland and Scotland north of the Cheviots; lettering and railways are printed in grey, and streams in blue. The two maps issued to date illustrate the exposed coalfields with their concealed extensions, and the occurrences of iron ore—the relevant geological outcrops or divisions being printed in colour. Other maps in course of preparation will deal with limestones and metalliferous ores.

A geological map of England and Wales on this scale is to be taken in hand in 1936.

Eight more of the series of colour-printed six-inch maps of the London area have been published, and nineteen were passing through the press at the end of the year. No more are being sent forward at present, but the series may be extended in future if warranted by sufficient demand.

Six-inch maps of the Biggleswade district are in process of standardization. When they are completed the one-inch map (Sheet 204) will be prepared for engraving. This is the second of the four sheets centred on Cambridge of which one (Saffron Walden) is published and a third (Huntingdon) well in hand.

Most of the programme of field-work for the Witney Sheet has been carried out, and the one-inch New Series map (236) will be prepared for engraving in 1936. This will replace portions of the Old Series hand-coloured sheets, 44, 45, 34 and 13, and is based on a full six-inch survey of the drifts and a partial six-inch survey of the solid geology, the remainder to be reproduced, after necessary checking, from the Old Series maps.

Drift editions of the Isle of Wight (Special) and Aldershot (285) sheets, with slight emendations in line or colour, were reissued during the year, since the previous editions of these popular maps were sold out. The Sidmouth map (326/340) is in similar case, and a reprint of the drift edition on the improved colour scheme now in vogue, is passing through the press.

At the end of the year the drawing of the Dudley Sheet (167) for the engraver was well advanced. The sheet, which includes part

of the South Staffordshire Coalfield, with the well-known Silurian inliers of Dudley and the Wrens Nest, will be issued in drift and solid editions.

The drift edition of the important Wigan Sheet (84) has now been issued, and the solid edition will be published early in 1936. The structure of this part of the Lancashire Coalfield is complex, owing to heavy faulting, warping and unconformities. Outstanding six-inch coalfield maps covered by the one-inch sheet, have all been published during the year, and those of the Preston Sheet to the north are being prepared for engraving. The one-inch Preston Sheet (75) is to be sent to press in 1936. The geology is more simple than that of the Wigan Sheet and includes large tracts of drift-covered New Red Sandstone.

The one-inch Gosforth Sheet (37), Cumberland, in solid and drift editions, was passing through the press at the end of the year. One six-inch map covering an important part of the concealed haematite iron-field is to be published. The Cockermouth one-inch Sheet (23) will be drafted in 1936.

In Yorkshire the energies of the staff have been concentrated chiefly on six-inch coalfield maps. Eighteen sheets have been published during the year and sixteen were in the press on 31st December. In 1936 the one-inch reduction of the New Series Barnsley (87) and Wakefield (78) sheets will be taken in hand for engraving. These are both important sheets, covering some of the most valuable parts of the North Yorkshire Coalfield, both exposed and concealed.

No one-inch maps of Northumberland have appeared during the year, but of the twenty-eight six-inch coalfield maps issued, six have come from this district, and four were in the press at the end of the period. As the field-unit working this district becomes more involved in the heart of the Northumberland-Durham Coalfield an increased flow of six-inch maps for publication is anticipated.

In none of the other areas, Bridport, Sevenoaks, Droitwich, Huntingdon, the Forest of Dean, Bradford, Warrington or Northumberland, has mapping advanced far enough to consider one-inch publication at present.

SCOTLAND.—Preparations are in hand for the publication of an up-to-date geological map of Scotland based on the 10 miles to 1 inch Ordnance Survey map. This map is on the same scale as the well-known map by Sir A. Geikie issued by Messrs. John Bartholomew and Son, Ltd., which is now out of print. The map will receive a thorough revision, embodying as much important work as possible that has been published in the time interval. Parts that will necessarily receive least attention will be those of which a primary survey has not yet been made in the Highlands and the Outer Isles.

No one-inch maps were published during the year, but three were in the press at its close, two being the solid and drift editions of the Sanquhar Sheet (15), in which the Carboniferous and Old Red Sandstone areas have received recently a thorough revision, and the other the Jedburgh Sheet (17), a ' solid with drift ' edition which has been brought up-to-date. As stated last year these sheets contain large areas of Ordovician and Silurian rocks which were re-mapped many years ago by Peach and Horne, and the results were published in the memoir on the Silurian rocks of Scotland. A separate economic memoir, however, is to be issued on the revised Sanquhar Coalfield. Three or four of the new colour-printed Sheets of the South of Scotland are still required to bring the series up-to-date.

The Morvern Sheet is in course of drafting for publication, and work has been begun on the sheets covering the Shetland Islands. Two six-inch coalfield maps have been issued during the year, representing parts of the Fifeshire and Lanarkshire Coalfields. Dr. T. Robertson and, towards the end of the year, Dr. E. M. Anderson, have been employed in preparing coalfield maps of parts of the Central Valley, to be issued on a new Meridian. This is most important work, since the boundaries of the new sheets do not coincide with those of the existing geological sheets. New Explanations and Sections are required before re-issue, and the opportunity is being taken to incorporate new mining information.

One Sheet of Vertical Sections (23) illustrating part of the Central Coalfield of Scotland was in the press at the close of 1935.

The list of Maps and Vertical Sections published and in the press during the year is given below :—

English and Welsh Maps published in 1935

1: 1,000,000 (Economic Maps) :—

The Coalfields of England and Wales.

The Iron Ores of England and Wales.

¼ inch to 1 mile :—

Sheet 8.—Flamborough Head and Grimsby (*Solid, Revised*).

Sheet 8.—Flamborough Head and Grimsby (*Drift, Revised*).

1 inch to 1 mile :—

Isle of Wight. Original survey on one-inch scale by H. W. Bristow and W. T. Aveline; A. C. Ramsay, Local Director, and published in 1856. Isle of Wight resurveyed on six-inch scale by Clement Reid (Tertiary) and Aubrey Strahan (Cretaceous). H. W. Bristow, Senior Director. Resurvey published in 1888. Mainland resurveyed on the six-inch scale by Clement Reid and published in 1895. New edition 1926. Reprinted with emendations 1935.

Sheet 84.—Wigan (*Drift*). Original survey published on Old Series Maps. Resurveyed by R. C. B. Jones, L. H. Tonks, R. L. Sherlock (Geologists) and W. B. Wright (District Geologist).

Sheet 285.—Aldershot (*Drift Reprinted*). Original survey on one-inch scale and published on Old Series Maps Re-surveyed on six-inch scale by C. N. Bromehead, H. G. Dines and F. H. Edmunds; H. Dewey, District Geologist. Published 1928. Republished with slight emendations.

6 inches to 1 mile (coalfield maps) :—

Cheshire, 11 N.E.—Mottram. Original survey (western margin) by W. Hull. Resurveyed by W. Lloyd. Remainder surveyed by J. V. Stephens and Wilfrid Edwards; C. E. N. Bromehead, District Geologist.

Cumberland, 36, N.E.—Mealsgate. Original survey by T. V. Holmes. Resurveyed by T. Eastwood; B. Smith, District Geologist.

Lancashire, 92 S.E.—Holland Moss. Original survey by E. Hull. Resurveyed by Laurence H Tonks; W. B. Wright, District Geologist.

Lancashire, 94 S.W.—Hindley. Original survey by E. Hull. Resurveyed by R. C. B. Jones; W. B. Wright, District Geologist.

Northumberland, N.78 N.E.—Blyth. Original survey by H. H. Howell. Revised by V. A. Eyles; R. G. Carruthers, District Geologist.

Northumberland, N.78 S.W.—Shankhouse, Seaton Delaval. Original survey by H. H. Howell and W. Topley. Revised by G. A. Burnett; R. G. Carruthers, District Geologist.

Northumberland, N.78 S.E.—Seaton Sluice. Original survey by H. H. Howell and W. Topley. Revised by G. A. Burnett; R. G. Carruthers, District Geologist.

Northumberland, N.86 N.E.—Holywell. Original survey by H. H. Howell. Revised by G. A. Burnett; R. G. Carruthers, District Geologist.

Northumberland, N.87 N.W.—Whitley Bay. Original survey by H. H. Howell. Revised by G. A. Burnett; R. G. Carruthers, District Geologist.

Northumberland, N.87 S.W.—Whitley Bay. Original survey by H. H. Howell. Revised by G. A. Burnett; R. G. Carruthers, District Geologist.

Yorkshire, 219 S.E.—Ledsham. Original survey by W. T. Aveline, J. C. Ward and R. Russell. Resurveyed by Wilfrid Edwards; C. N. Bromehead, District Geologist.

Yorkshire, 233 N.W.—Middleton. Original survey by A. H. Green, R. Russell and T. V. Holmes. Resurveyed by Wilfrid Edwards; C. N. Bromehead, District Geologist.

Yorkshire, 233 N.E.—Rothwell. Original survey by A. H. Green, R. Russell and T. V. Holmes. Resurveyed by Wilfrid Edwards; C. N. Bromehead, District Geologist.

Yorkshire, 233 S. W.—Ardsley East. Original survey by A. H. Green, R. Russell and T. V. Holmes. Resurveyed by Wilfrid Edwards; C. N. Bromehead, District Geologist.

Yorkshire, 233 S.E.—Stanley. Original survey by A. H. Green, R. Russell, and T. V. Holmes. Resurveyed by W. N. Edwards; C. N. Bromehead, District Geologist.

Yorkshire, 261 S.E.—Skelmanthorpe. Original survey by A. H. Green and R. Russell. Resurveyed by D. A. Wray; C. N. Bromehead, District Geologist.

Yorkshire, 262 S.W.—Darton. Original survey by A. H. Green. Resurveyed by D. A. Wray; C. N. Bromehead, District Geologist.

Yorkshire, 263 N.E.—Badsworth Common. Original survey by A. H. Green. Resurveyed by G. H. Mitchell; C. N. Bromehead, District Geologist.

Yorkshire, 263 S.E.—South Kirkby. Original survey by A. H. Green. Resurveyed by G. H. Mitchell; C. N. Bromehead, District Geologist.

Yorkshire, 264 N.W.—Upton. Original survey by W. T. Aveline and

A. H. Green. Resurveyed by G. H. Mitchell; C. N. Bromehead, District Geologist.

Yorkshire, 274 N.W.—Cawthorn. Original survey by A. H. Green. Resurveyed by C. N. Bromehead, District Geologist.

Yorkshire, 274 S.W.—Silkstone. Original survey by A. H. Green. Resurveyed by C. N. Bromehead, District Geologist.

Yorkshire, 275 N.E.—Clayton. Original survey by A. H. Green and R. Russell. Resurvey by G. H. Mitchell; C. N. Bromehead, District Geologist.

Yorkshire, 275 S.E.—Billingley. Original survey by A. H. Green and R. Russell. Resurveyed by G. H. Mitchell; C. N. Bromehead, District Geologist.

Yorkshire, 276 S.W.—Hickleton. Original survey by W. T. Aveline and A. H. Green. Resurveyed by G. H. Mitchell; C. N. Bromehead, District Geologist.

Yorkshire, 281 N.E.—Cubley. Original survey by J. R. Dakyns. Resurveyed by G. V. Wilson; C. N. Bromehead, District Geologist.

Yorkshire, 283 N.E.—Wath upon Dearne. Original survey by A. H. Green and R. Russell. Resurveyed by G. H. Mitchell; C. N. Bromehead, District Geologist.

Yorkshire, 283 S.E.—Swinton. Original survey by A. H. Green and R. Russell. Resurveyed by G. H. Mitchell; C. N. Bromehead, District Geologist.

6 inches to 1 mile maps of London District (Colour printed) :—

London, N.3 S.W. (Essex N.78 S.W.).—Leyton, Wanstead Flats. Original survey by J. A. Howe and C. N. Bromehead. Modifications and additional notes by S. Buchan; H. Dewey, District Geologist.

London, N.3 S.E. (Essex N.78 S.E.).—Ilford. Original survey by J. A. Howe. Additional notes by S. Buchan; H. Dewey, District Geologist.

London, N.5 N.W.—St. Pancras. Original survey by A. C. G. Cameron and C. N. Bromehead. Modifications and additional notes by F. B. A. Welch; H. Dewey, District Geologist.

London, N.5 N.E.—London Fields. Original survey by C. N. Bromehead. Modification and additional notes by F. B. A. Welch; H. Dewey, District Geologist.

London, N.6 S.W. (Essex N.86 S.W.).—Canning Town. Original survey by C. N. Bromehead; G. Barrow, District Geologist. Modifications and additional notes by F. B. A. Welch; H. Dewey, District Geologist.

London, N.8 N.W. (Middlesex 21 N.W.).—Chiswick. Original survey by A. C. G. Cameron and T. I. Pocock. Lines between River Terraces by C. N. Bromehead. Alterations and additional notes by R. L. Sherlock; H. Dewey, District Geologist.

London, N.8 N.E.—Fulham. Original survey by C. N. Bromehead and T. I. Pocock. Alterations and additional notes by R. L. Sherlock; H. Dewey, District Geologist.

London, N.9 N.W.—Kennington. Original survey by C. N. Bromehead; G. Barrow, District Geologist. Modifications and additional notes by F. B. A. Welch; H. Dewey, District Geologist.

Scottish Maps published in 1935

6 inches to 1 mile (Coalfield maps) :—

Fifeshire, 28 N.W.—Markinch. Original survey by H. H. Howell. Revised by J. Knox.

Lanarkshire, 6 N.E.—Glasgow (Springburn). Original survey by Edward Hull and R. L. Jack. Revised by L. W. Hinxman and R. G. Carruthers. Additional information by J. K. Allan.

Manuscript copies of the following maps on the scale of six inches to one mile were deposited in the Library for public reference. They are not to be published. The English reference maps are deposited in the head office in London. These manuscript copies of unpublished maps may be examined in the Library of the Geological Survey, Exhibition Road, South Kensington, London, S.W.7, on week-days from 10 a.m. to 5 p.m. Copies of them may be obtained at the cost of drawing and colouring, which will be quoted on application to the Superintendent of Maps. Photographs of these maps will also be supplied on the scale of 3 inches to 1 mile approximately, at the cost of 2s. 6d. to 4s. 6d. per quarter sheet.

The Scottish manuscript copies, which are deposited in the office at 19, Grange Terrace, Edinburgh, may, on application, be forwarded to the London Office for consultation.

English Manuscript Maps Deposited for Reference

Berkshire, 27 N.W., N.E., S.W., S.E.

Scottish Manuscript Maps Deposited for Reference

Argyllshire, 181 N.W., N.E., S.W., S.E.; 182 N.W., N.E., S.W., S.E.; 183 N.W., N.E., S.W., S.E.; 184 N.W., N.E.

English Maps in the Press at the close of 1935

½ inch to 1 mile :—

Sheet 1 with 2.—Alnwick, Berwick, etc. (***Solid, new edition***).
Sheet 12.—Louth, Peterborough, Norwich, Yarmouth (***Solid, new edition***).
Sheet 12.—Louth, Peterborough, Norwich, Yarmouth (***Drift, new edition***).
Sheet 23.—Bournemouth, Isle of Wight, Selsey Bill (***Solid, new edition***).

1 inch to 1 mile :—

Sheet 37.—Gosforth (*Solid*).
Sheet 37.—Gosforth (*Drift*).
Sheet 84.—Wigan (*Solid*).
Sheet 326/340.—Sidmouth (*Drift. Reprinting*).

6 inches to 1 mile (Coalfield maps) :—

Northumberland, N. 67 S.E.; N.75 N.E., S.E.; 78 N.W.
Yorkshire, 219 N.W.; 234 N.W., N.E., S.W., S.E.; 249 N.W., N.E., S.E., 262 S.E., 274 N.E., S.E.; 282 N.W., N.E., S.W.; 288 N.E.; 289 N.E.

6 inches to 1 mile Maps of London District (Colour printed) :—

London, N.5 S.W., S.E.; N.6 N.E., S.E. and 7 S.W.; N.8 S.W., S.E.; N.9 N.E., S.W., S.E.; N.10 N.W., N.E. and 11 N.W., S.W., S.E.; N. 12 N.W., N.E.; N.13 N.W., N.E.; N.14 N.W., N.E.

Scottish Maps in the Press at the close of 1935

1 inch to 1 mile :—

Sheet 15.—Sanquhar (*Solid edition*).
Sheet 15.—Sanquhar (*Drift edition*).
Sheet 17.—Jedburgh (*Solid with Drift edition*).

Scottish Vertical Sections in the Press at the close of 1935

Sheet 23.—Vertical sections illustrating the Central Coalfield Area I.—Kilsyth and Kirkintillock districts.

Memoirs

Part I of the *Summary of Progress* was issued as usual, but Part II, containing nine papers upon miscellaneous subjects, had not passed through the press at the end of the year. The most important issue was that of a number of the Handbooks with the general title of ' British Regional Geology ' which, as explained last year, will serve as welcome summaries of the geology of the eighteen broad districts into which Great Britain has been divided for the purpose of illustration in the Museum. The books have been written in simple and attractive form by the geologists who arranged the regional exhibits in the Museum, and since the two are planned on parallel lines, the handbooks will serve as guides to the exhibits as well as to the actual districts that may be visited in the field by the student or interested tourist. The average length of the volumes is from 80 to 90 pages, including illustrations in the text; and they usually contain eight or more photographic plates. Those that have appeared have received very favourable notice and great interest is being taken in them by the geography schools as well as by geologists, for particular attention is drawn to physical features and the origin of the scenery. The following are the titles of the ten handbooks that have appeared during the year:—London and Thames Valley, the Wealden District, Bristol and Gloucester District, the Welsh Borders, Northern England, North Wales, South-West England, Tertiary Volcanic Districts of Scotland, the South of Scotland, and the Grampian Highlands. In the press at the close of the year were:—The Pennines and Adjacent Areas, and the Midland Valley of Scotland. The remainder, in course of preparation, are entitled:—The Hampshire Basin, the East Anglian District, Central England, East Yorkshire and Lincolnshire, South Wales, and the Northern Highlands. It is expected that some of these will be published during 1936.

England and Wales.—Apart from the seven of the ten handbooks on Regional Geology mentioned above, the only memoir issued during the year was one on ' The Wells and Springs of Herefordshire,' by Mr. L. Richardson. This gives a fairly complete picture of the water supply from all sources in the county, most parts of which were visited by the author. It brings the number of Water Supply Memoirs up to 27, covering 32 counties. ' Records of London Wells,' one of the most important volumes in this series, has been out of print for some time and a new edition is called for. Since a re-issue of this work with the latest information would form an unwieldy volume and would involve considerable delay in publication, it has been decided to publish

a volume entitled ' The Wells of London County,' which will be fully up-to-date but will cover a smaller area than did ' London Wells '. Dr. S. Buchan was engaged upon its preparation during the latter part of the year. Later on, records of the wells of outlying parts of the larger area may be issued as supplements to the memoirs on water supply dealing with the surrounding counties within the boundaries of which they occur.

At the close of the year the only English memoirs in the press were: ' The Geology of the Country Around Rothbury, Amble and Ashington ' (Explanation of Sheets 9 and 10), by Mr. A. Fowler, and one handbook in the British Regional Geology Series, ' The Pennines and Adjacent Areas ', by Dr. D. A. Wray. Several volumes were so advanced that they are expected to be sent to press early in 1936. These comprise memoirs on the Shrewsbury District (Sheet 152), the manuscript of which has been edited by Mr. T. H. Whitehead; the Wigan District (Sheet 84), an important coalfield described by Dr. W. B. Wright and his staff; and the Gosforth District (Sheet 37), with its haematite Ironfield described by Mr. T. Eastwood and staff; as well as handbooks on Central England by Messrs. F. H. Edmunds and K. P. Oakley, and on the Hampshire Basin and the Isle of Wight by Mr. C. P. Chatwin.

The writing up of memoirs on the geology of the Preston (Sheet 75), Cockermouth (Sheet 23), Barnsley (Sheet 87), Wakefield (Sheet 78), and Dudley (Sheet 167) districts has been taken in hand. Mr. Linsdall Richardson has made good progress with the explanation of the Witney map (Sheet 236), Oxfordshire. In this he will receive collaboration from Mr. H. G. Dines, who spent his field season on the ground. The Biggleswade map (Sheet 204) has been surveyed and the memoir will be commenced as soon as possible.

Scotland.—The first complete account of the geology of the Orkneys was issued during the year, having been preceded by the publication of the quarter-inch and one-inch maps of the Islands. The memoir was written in the main by Mr. G. V. Wilson and others of his staff, but contains, in addition, important chapters on the dyke-rocks, fossil plants and fishes by specialists on those subjects.

Three of the ten handbooks on British Regional Geology published during the year described Scottish districts. One by Dr. M. Macgregor and Mr. A. G. MacGregor on the Midland Valley of Scotland was in the press, and another on the Northern Highlands is being prepared by Dr. J. Phemister.

Important coalfield memoirs are in hand. That on the Geology of the Sanquhar Coalfield and Adjacent Basin of Thornhill by Dr. Richey and his staff, in collaboration with Dr. J. Pringle, was almost ready for the press at the end of the year. The Sanquhar Coalfield has long been an important mining centre and special

attention is paid in the memoir to its economic development and resources. 'The Economic Geology of the Central Coalfield, Area I, Kilsyth and Kirkintilloch,' by Dr. T. Robertson and Mr. D. Haldane is almost in as advanced a stage. This memoir describes important mining centres of coking coals and anthracite, and will complete the series of nine devoted to an account—mainly from an economic standpoint—of the Central Coalfield of Scotland. Messrs. J. Knox and J. K. Allan are writing up the economic geology of the Fife Coalfields, Area III, which deals in the main with the important mining districts of Dysart, Wemyss, Leven and Balgonie. One sheet memoir, on the geology of Central Ayrshire (Explanation of Sheet 14), has been commenced. The Explanation of Sheet 23 (Lanark), the Shetland Islands memoir, and the Explanation of Sheet 52 (Morvern and Sunart) will follow in due course.

English Memoirs Published in 1935

Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1934:—
Part I.—With Report of the Geological Survey Board and Report of the Director. 85 pp. 1935. Price 1*s.* 6*d. net.*
Wells and Springs of Herefordshire. By L. Richardson, F.R.S.E., P. A. Inst. W.E., F.G.S. 136 pp., 2 plates, 1 text-figure. 1935. Price 3*s. net.*
British Regional Geology:—
Bristol and Gloucester District. By F. B. A. Welch, B.Sc., Ph.D. and R. Crookall, D.Sc., Ph.D. 89 pp., 12 plates, 27 text-figures. 1935. Price 1*s* 6*d. net.*
London and Thames Valley. By R. L. Sherlock, D.Sc., A.R.C.Sc., 70 pp., 5 plates, 24 text-figures. 1935. Price 1*s.* 6*d. net.*
Northern England. By T. Eastwood, A.R.C.Sc. 76 pp., 8 plates, 26 text-figures. 1935. Price 1*s.* 6*d. net.*
North Wales. By Bernard Smith, M.A., Sc.D., F.R.S. and T. Neville George, D.Sc., Ph.D. (*Professor of Geology; University College of Swansea*).. 92 pp., 12 plates, 30 text-figures. 1935. Price 1*s.* 6*d. net.*
The Wealden District. By F. H. Edmunds, M.A. 85 pp., 13 plates, 21 text-figures. 1935. Price 1*s.* 6*d.*
The Welsh Borderland. By R. W. Pocock, D.Sc., and T. H. Whitehead, M.Sc., A.R.C.Sc. 84 pp., 11 plates, 39 text-figures. 1935. Price 1*s.* 6*d. net.*
South-West England. By Henry Dewey. 75 pp., 10 plates, 20 text-figures. 1935. Price 1*s.* 6*d. net.*

English Memoirs in the Press at the close of 1935

The Geology of the Country around Rothbury, Amble and Ashington (Explanation of one-inch Sheets 9 and 10: England and Wales).
British Regional Geology:
The Pennines and Adjacent Areas.

Scottish Memoirs published in 1935

Summary of Progress. *See above.*
The Geology of the Orkneys. By G. V. Wilson, B.Sc., and Wilfrid Edwards, M.A., John Knox, B.Sc., R. C. B. Jones, M.C., M.Sc., J. V. Stephens,

B.Sc., with chapters on the Fossil Fishes by Prof. D. M. S. Watson, F.R.S. Fossil Plants by Professor W. H. Lang, F.R.S. Petrography by Sir John S. Flett, F.R.S. 205 pp., 8 plates, 36 text-figures, Index-map. 1935. Price 5*s. net.*

British Regional Geology :—

The Tertiary Volcanic Districts. By J. E. Richey, M.C., Sc.D. 115 pp., 9 plates, 57 text-figures. 1935. Price 1*s.* 6*d. net.*

The Grampian Highlands. By H. H. Read, D.Sc., A.R.C.Sc. 81 pp., 10 plates, 25 text-figures. 1935. Price 1*s.* 6*d. net.*

Scotland: The South of Scotland. By J. Pringle, D.Sc. 97 pp., 7 plates, 14 text-figures. 1935. Price 1*s.* 6*d. net.*

Scottish Memoirs in the Press at the close of 1935

British Regional Geology :—

Midland Valley of Scotland.

Shafts, Sinkings and Borings

Under Section 23 of the Mining Industry Act of 1926, all borings and sinkings for minerals in Great Britain that are expected to exceed 100 feet in depth from the surface have to be notified to the Director of the Geological Survey of Great Britain.

During 1935 fourteen notifications were received for England and Wales. Most of the records of these were confidential, but it may be said that in two cases shell bands (*C. subconstricta* and *C. pseudorobusta*) indicating the position in the bore with regard to the local coal seam were observed.

Numerous records of wells were received from Engineers and others, and Mr. Templeman, in addition to visiting notified borings and shafts, has copied upwards of 1,200 records and sited the positions of the bores upon the one-inch maps. He has kept records of the bores for coal and other minerals, classified the results and drawn scaled sections, and has collected suites of lithological specimens as well as fossils where it was considered to be necessary.

The notified borings visited by the geologists responsible for the survey of the district in which they occur were chiefly in search of coal, but a series in Cumberland to test the distribution of haematite was reported on by Dr. Trotter.

Forty-one notifications of borings, shafts and mines were received in Scotland. As in former years, several of these notifications have included two or more bores and in some instances a series of bores. The inspection has been mainly carried out by Mr. Manson, though visits have also been made by officers concerned with the mapping of areas where such operations were in progress. The sites of all new bores, shafts and mines have been carefully recorded on the six-inch working maps. Copies of journals have been obtained and checked, but in some cases of mines driven from the surface and underground in collieries it

has been necessary for the inspecting officer to compile journals of the strata encountered. The majority of the records obtained have been prepared in graphic form in order that ready comparison may be made with the sections of other bores or shafts in the custody of the department. Extensive suites of fossils and lithological specimens have been collected and registered in the Survey collections. During the year several comparatively deep borings have been in progress and particular attention has been given to one which is being put down to prove the thicknesses of the coal seams of the Limestone Coal Group in the Hamilton district. Numerous enquiries from mining engineers regarding the interpretation of sections of strata proved in borings and mines have been dealt with. Among the more interesting and important data gathered from the examination of borings and mines the following may be mentioned.

Two borings put down north of the River Forth about midway between the village of Cambus and the town of Alloa have proved the Castlecary Limestone. The thickness of the limestone was almost the same in both bores (7-8 ft.); the component beds and associated strata were also closely similar. The limestone is dolomitic and there is some evidence of contemporaneous erosion above it.

Sections of portions of the Lower Limestone Group have been measured in an undersea mine in Bridgeness Colliery in the Bo'ness district. Reference may be made here to one of the limestones exposed in the mine, the No. 5 Carriden Limestone. In the district the only outcrop of this bed occurs on the foreshore west of Carriden Fishery, where it was discovered by the late Dr. H. M. Cadell in 1921.[1] It is, however, but poorly exposed and the only complete sections[2] of the limestone and its associated strata have been obtained from bores put down in the Bridgeness and Carriden districts. In the mine the limestone appears as a dark crinoidal rock, 8 ft. 8 in. thick, and is both overlain and underlain by blaes with marine shells. The overlying blaes, representing the Neilson Shell-bed of the West of Scotland, have yielded a fauna mainly composed of gastropods and cephalopods with a few lamellibranchs and one coral. One of the lamellibranchs, *Posidonia* aff. *corrugata* R. Eth., jun., was present in fair quantity. It is a shell considerably larger than the forms of *P. corrugata* usually found in the Lower and Upper Limestone Groups. It is, however, identical with specimens recently obtained from the Neilson Shell-bed in a boring in the Kilsyth district and may prove of considerable stratigraphical value in future work.

The blaes underlying the limestone contained an interesting series of fossils, of which *Naiadites* [*Myalina*] *crassa* (Flem.) was

[1] 'The Rocks of West Lothian,' 1925, p. 79.
[2] *See* 'Economic Geology of the Central Coalfield, Area III' (*Mem. Geol. Surv.*), 1933, p. 27.

present in considerable numbers, forming a layer at the base of the bed.

The fossils referred to above have been determined by Mr. F. W. Anderson.

Petroleum

By the Petroleum (Production) Act, 1934, the property in petroleum existing in its natural condition in Great Britain became vested in His Majesty, and the Board of Trade, on behalf of His Majesty, were empowered to grant licences to search and to bore for petroleum. Under the Act, licences have been granted to search for oil at a number of districts in the counties of Dorset, Wiltshire, Berkshire, Hampshire (Southampton), Sussex, Surrey, Lincolnshire, Yorkshire, Derbyshire and Nottinghamshire, making a total area of upwards of 6,000 square miles. A start has been made in Sussex and Hampshire. Under the Act these borings have to be notified to the Director of the Geological Survey and some notifications have been received already.

Water Supply

The break up of the drought in the late summer did not afford immediate relief to the water shortage, but in the Chalk districts of the South of England copious springs finally broke out in their old positions and water courses that had become completely grass-covered resumed their normal flooded condition. In Surrey the lag of the outflow after the heavy autumn rains appears to have been, as formerly, four to five months. With regard to the London Basin, however, it is disturbing to find that the replenishment of underground water is more than used up by the heavy pumping in sub-artesian wells in the City and West End and the steady persistent fall in the rest-level of the water in the Chalk has been replaced by rapidly accelerated falls. Such records as are available show this continual fall in the water-level, and in spite of the heavy rainfall pumping is removing more water than gains access by natural influx. The following instances show the average annual falls:—Leadenhall Street, 6 feet per annum: in the area north-east of St. Paul's Cathedral, 11 feet per annum: Aldersgate Street, 7 feet per annum: Lincoln's Inn, 7 feet; and in parts of the City, 11 feet. What is an equally disturbing fact is that the yields from the wells are also diminishing, in some instances rapidly. The general level below Ordnance Datum for the City and West End is now over 250 feet. In many wells the Upper Chalk has been passed through; the Middle and the Lower Chalk are normally not to any extent water-bearing and as the Lower Greensand probably occurs nowhere below London an artesian water shortage seems imminent in some areas.

Numerous enquiries have been made with regard to artesian water generally in England, and helpful information has been afforded in many cases. For example a boring at Clandon proved an abnormal type of Gault, but the depth to the Lower Greensand, that was estimated by Mr. Edmunds, proved approximately correct. The yield has not been tested although the beds are water-bearing. The Lower Greensand has again been proved near Slough; its thickness so far is not known as boring operations are being continued. An interesting instance of an abnormally soft water is that from a boring near Victoria Station. Water gained access from the Thanet Beds and although the boring was continued to over 345 feet in the Chalk the water retains its soft properties.

Much of the advice given is to the effect that boring at the places proposed would be futile, but elsewhere boring has been continued with success. Thus Dr. Wright records a yield of 40,000 gallons of water an hour from a well 500 feet deep, in Cheshire.

Geological information obtained as a result of boring for water has proved of much importance. To give but two cases, Mr. Dixon records an interesting bore at Hollwellbury Farm, Lower Stondon, where a channel that probably reaches the Ampthill Clay had been cut to a depth of at least 268 feet and subsequently infilled with drift deposits. The records of these deep sub-glacial channels are accumulating: they show that the infilling process was of common occurrence in the Glacial period. Two adjacent borings, one at Stratton Audley and the other at Middleton Park, Oxfordshire, supplied a fine series of specimens of fossils from the local base of the Jurassic beds, and from the Lias. A supply of water was obtained from the Marlstone at Middleton Park, while the Jurassic rocks were water-bearing at Stratton Audley.

As in previous years reports on geological questions, arising out of proposed schemes for obtaining urban or rural water supplies, have been furnished on request to the Ministry of Health.

London's 'Buried Rivers'

The value of geological advice is increasingly appreciated by the public and among the number of enquiries dealt with several were related to the occurrence of former stream courses in London. These are partially infilled, diverted in sewers or drains or left to soak away as they can. But after heavy rain the streams tend to resume their courses in their old alluvium, and adversely affect the foundations of buildings. For this reason an attempt to show them on the six-inch colour-printed maps of London has been made, after tracing their courses through the streets. Those in North London were traced in 1934, while many were followed during 1935 in South London.

Inland Water Survey

The Geological Survey has taken an active part in the work of the Inland Water Survey during the year. In February, Dr. B. Smith, while Assistant to the Director, was appointed as an Assessor on the Committee appointed by the Minister of Health and the Secretary of State for Scotland to advise on an Inland Water Survey for Great Britain, and has attended all meetings held during the year.

At the request of this Committee arrangements were made with the Department of Scientific and Industrial Research, whereby the Geological Survey undertook certain preliminary work in connexion with replies to a questionnaire which had been issued by the Committee. This work was entrusted to Mr. F. H. Edmunds who has correlated the information contained in these replies and that already in the possession of the Geological Survey, in so far as it dealt with the Nene Catchment Area, and to a less extent, with that of the Thames above Teddington. These areas were the first to be chosen by the Committee for close examination. It was found that, in order adequately to assimilate into one collection data from these two main sources, and to utilize them for purposes of a Water Survey, it would be necessary to re-organize the system of filing of Geological Survey records. These are at present assembled on a County basis, but new files are to be made, on the basis of one mile to one inch maps. This work has been commenced.

Mr. Edmunds prepared a Memorandum, with five appendices, for submission to the Inland Water Survey Committee, in which some of the problems peculiar to a survey of underground water resources were propounded. This memorandum the Committee adopted. He has also prepared a map showing the distribution, and also isopachytes (*i.e.* lines of equal thickness) of the water-bearing Northampton Beds of the Nene Catchment Area.

Reviewing possible future work in connexion with water-levels, in case some voluntary outside assistance may be desirable, the headmasters of various Public and Secondary schools have been approached, tentatively, to discover to what extent help may be expected from them : the response has been enthusiastic.

Agriculture and Soil Science

The annual field meeting of the Soil Surveyors' Conference took place at Dartington, near Totnes, Devon, from 6th to 13th April. Mr. H. G. Dines, who is a member of the Executive Committee, accompanied Dr. T. Wallace of Long Ashton Research Station, Bristol, to Dartington on the 18th of March and, with Mr. J. B. E. Patterson, of Dartington Hall Ltd., selected a suitable area for soil survey. This comprises woodland, pasture and arable land, situated on outcrops of Middle Devonian slates, tuffs and limestones, with intrusive diabase; there are also small tracks of terraced river gravel and alluvium of the River Dart,

composed, to a large extent, of material derived from the Dartmoor granite. Mr. Dines explained the geology of the district at the outset, and throughout the field meeting advised the groups of surveyors when occasion arose. The work differed from that carried out at Kyloe in 1934, in that the soils in Devon had already been mapped by Mr. Patterson. Descriptions of the soil series present and results of analyses were placed at the disposal of members for reference, but the actual survey of the area was carried out anew by the surveyors, who worked in four groups. The maps they produced show a close similarity to one another, differing only in detail.

At a meeting of the Executive Committee at Dartington, on April 10th, colour standards for soil maps were discussed. Dr. D. A. Osmund had been asked to investigate the practicability of using ' Ridgway's Colour Atlas ', and he concluded that the Atlas did not provide a suitable basis. It was then agreed that the Secretary should procure sets of colour strips similar to those used by the Geological Survey. After a discussion on the classes of ' parent material ' included in a revised list, Mr. Dines was requested to draft another scheme.

At a meeting of the Executive Committee on the 9th of December, at the Ministry of Agriculture and Fisheries, the new list of ' parent material ' was considered and Mr. Dines was asked to draw up alternative schemes for the classification of sand and sandstone. At this meeting it was announced that the Agricultural Research Council had appointed a small committee under the chairmanship of Sir Daniel Hall to consider the future of soil survey organization in England and Wales. In the afternoon of the same day, at a full meeting of the Soil Surveyors' Conference, it was decided to hold the field meeting of 1936 in East Anglia. Mr. Dines was asked to assist in the selection of a suitable site when the locality had been fixed by Messrs. F. Hanley and H. H. Nicholson of Cambridge.

The Third International Congress of Soil Science

The third quinquennial congress of the International Society of Soil Science was held at Oxford from 30th July to 7th August. About four hundred soil investigators from many parts of the world were present. Mr. H. G. Dines and Dr. J. B. Simpson attended the congress as representatives of the Geological Survey. The activities of the Society are entrusted to six main Commissions. The Survey delegates devoted their services mainly to Commission V, which deals with soil genesis, morphology and cartography. After the congress, about 150 members took part in a tour of Great Britain, the route followed being :—Oxford, Wellington (Salop), Bangor, Perth, Aberdeen, Edinburgh, Newcastle, York, Cambridge. Mr. Dines accompanied the party in England and Dr. Simpson in Scotland. Throughout the congress the geolo-

gists discussed geological problems relating to soils with many eminent foreign soil experts, and on the excursions were frequently consulted about geological phenomena.

Forestry

Samples of soils from various parts of Great Britain, which from time to time are submitted by the Forest Products Research Laboratory, have been reported on by field geologists; and, as heretofore, information of a special kind has been provided on the character, probable thickness and local extent of the solid rocks, or the drift deposits overlying them, at the sites where the samples were taken.

At the request of the Forestry Commission, Mr. V. A. Eyles made an examination during the summer of part of Laggan Forest, Inverness-shire, with a view to making a report on the geology of the forest area that might be of assistance in the study of the forest soils. The area examined occupies a strip of country about $2\frac{1}{2}$ sq. miles in extent, that extends for about $3\frac{3}{4}$ miles along the south-east side of the Great Glen, and varies in width from $\frac{1}{2}$ to $\frac{3}{4}$ mile. It is shown on 1-inch Sheet 63 of the Ordnance Survey of Scotland, as lying immediately east of that part of the Caledonian Canal joining Loch Lochy to Loch Oich.

Topographically the forest falls into two distinct divisions: (1) a low lying area bounded by the Caledonian Canal on the west, and the Spean Bridge-Fort Augustus railway on the east; and (ii) an area of steep hillside rising abruptly from the railway to about 1,250 O.D. The area of low lying ground is relatively of small extent, and entirely covered with alluvial and glacial gravels. The latter extend up the hillside for short distances, but their limit is ill-defined owing to the thick cover of vegetation. Practically the whole of the hillside forest area is covered with young trees in various stages of growth, and there is, in addition, a thick undergrowth of heather, bracken, etc. Rock is, however, everywhere near the surface, and good exposures occur in the beds of several of the numerous streams that drain the hill.

The immediate area within which the forest lies is shown, on the 1910 edition of Geikie's Geological Map of Scotland, as being occupied by sedimentary rocks of Middle Old Red Sandstone age. A narrow strip of this formation is indicated as extending along the east side of the Great Glen from the north end of Loch Lochy past Loch Oich to within a few miles of Fort Augustus. The examination of Laggan Forest has shown that this outcrop is not continuous. Within the forest area there is a narrow outcrop, about one-quarter of a mile broad, of conglomerates and flagstones of Middle Old Red Sandstone age, that crosses the forest obliquely. It runs about north 40° east, a few degrees farther east-of-north than the line of the Great Glen. On either side of this narrow outcrop there occur metamorphic rocks. Both the Old Red Sand-

stone rocks and the schists on each side strike about north-east, with local variations. The sandstones dip south-east at fairly high angles. The schists are in places vertical, but often inclined steeply to the south-east. The relationship of the Middle Old Red Sandstone to the schists on the east is clearly one of faulting, but whether the metamorphic rocks that lie to the west are also in faulted contact, or whether the Middle Old Red conglomerate overlies the schists unconformably, has not yet been determined.

The metamorphic rocks of the Laggan Forest area are unlike the Moine gneisses that occur to the north, and appear to form part of the great series of Dalradian schists that outcrop farther south. They include quartzites, pebbly mica-schists, calcareous mica-schists, black slaty phyllites and other types. Of particular interest is the occurrence among them of a thick conglomerate or boulder bed, containing pebbles up to eight inches long. This lies to the west of the narrow outcrop of Middle Old Red Sandstone.

A more detailed report on this area is in course of preparation.

Building Stones Research

In February Mr. F. H. Edmunds, in company with Mr. J. H. Markham, of H.M. Office of Works, and Mr. B. Bakewell, of the Building Research Station, visited several quarries in Rutlandshire and in the Cotswold Hills in connexion with the selection of stone suitable for the repair of the Houses of Parliament. Recommendations by these officers, who comprise a Joint Committee set up for the purpose, were subsequently submitted to, and accepted by, the Board of H.M. Office of Works.

Mr. Edmunds maintains touch with the work on the repair of the Houses of Parliament.

Fuel Research

Co-operation has been maintained with the Local Committees of the Physical and Chemical Survey of the National Coal Resources formed under the Fuel Research Board, and also with members of the local Coal Associations.

New Committees have been set up during the year in the South Derbyshire and Cannock Chase Coalfields, where surveys are being started. Dr. B. Smith has withdrawn from the North Staffordshire Committee and his place has been taken by Dr. W. B. Wright.

The officers representing the Geological Survey on the various Local Committees are as follows:—

Scotland	Dr. Murray Macgregor
Northumberland and Durham	Mr. R. G. Carruthers
Cumberland	Mr. T. Eastwood
Yorkshire	Mr. C. E. N. Bromehead
Nottinghamshire and Derbyshire	Mr. C. E. N. Bromehead
South Derbyshire	Mr. T. Eastwood

Lancashire and Cheshire	Dr. W. B. Wright
North Staffordshire	Dr. W. B. Wright
Cannock Chase and South Staffordshire	Mr. C. H. Dinham
Forest of Dean	Mr. T. Eastwood
South Wales	Mr. E. E. L. Dixon

Water Pollution Research

Dr. W. B. Wright has continued to serve on the Committee of the Water Pollution Research Board of the Department of Scientific and Industrial Research that is investigating the effect of discharges of crude sewage on the accumulation and nature of the deposits in the Mersey Estuary. Possible sources of mud and clay deposited in the estuary have been surveyed. Samples of the deposits have been subjected to physical and chemical examination and compared with material from the bed of the Irish Sea and from other estuaries.

Samples of certain clays that occur in the South of England were collected and forwarded to the Department's Chemical Research Laboratory, where they have been subjected to treatment with the object of preparing materials suitable for water-softening. Some of the British Clays dealt with at the Laboratory are reported to be not only equal in base exchange value to imported treated clays in commercial use, but also more resistant to disintegration.

Conferences

At the British Association Meeting held in Norwich in September the Geological Survey was represented by Dr. B. Smith. Several members of the English and Scottish staffs were present and took part in discussions and field excursions. Survey maps and photographs were exhibited.

Mr. H. G. Dines and Dr. J. B. Simpson represented the Geological Survey at the 3rd International Congress of Soil Science, held at Oxford in August, and took part in excursions arranged in connexion with the meeting. Mr. H. G. Dines has been appointed a member of the Executive Committee of the Soil Surveyors' Conference.

Dr. B. Smith and Dr. J. Phemister act as Assessors to the Inland Water Survey Committee and the Road Research Board respectively.

Mr. F. H. Edmunds is a member of a Joint Committee of H.M. Office of Works, the Building Research Board and the Geological Survey on stone for repairs to the Houses of Parliament. Drs. B. Smith and W. B. Wright are acting on Sub-Committees of the International Union for Geodesy and Geophysics (Hydrology and Vulcanology).

Dr. A. F. Hallimond is a member of the British Engineering Standards Committee, and of a Sub-Committee of the Institute of Civil Engineers (Corrosion of Cement and Iron Pipes).

Dr. W. F. P. McLintock is a member of the Physico-Chemical Committee of the Building Research Station.

Mr. C. E. N. Bromehead is President of the Hull Geological Society, and of the Yorkshire Field Naturalist Society.

Dr. B. Smith has been awarded the Bolitho Medal by the Royal Geological Society of Cornwall.

Exhibits illustrating aspects of the work of the Geological Survey and Museum were shown at Conversaziones held by the Geological Society and the Geologists' Association, London.

Collaboration

Most useful help has been received in the preparation of Museum exhibits from two former members of the staff, Professors H. H. Read and T. N. George. The former also is author of ' The Grampian Highlands ' and the latter part author of ' North Wales ', in the British Regional Geology Series.

Professor E. J. Garwood, F.R.S., has continued to superintend the arrangement and registration of the fine series of fossils that illustrate his valuable contributions to British geology. These specimens he is kindly presenting to the Survey and Museum. He has been assisted in this work by Miss Odell, and the collection, in due course, will be made accessible to students and specialists. Some of the fossils have been chosen for display as part of the Stratigraphical Exhibit in the Museum.

Miss Tassart has made further drawings of fossils for reproduction.

Thanks are due to the Geological Society of London, the Geologists' Association, and to various geological and other societies, publishers and private persons for permission to reproduce text-figures or photographs in the handbooks on British Regional Geology.

Amongst the interesting donations received during the year is one that includes two albums of fine photographic prints from negatives illustrating the Yorkshire Caves and incidents in ' Cave hunting ' by the Leeds Cave Club. The photographs were taken by the late H. Wadsworth Haywood, F.R.P.S. of Leeds, who was a President of the Club, and were kindly presented by Miss Haywood. The albums have been placed in the Library and are available for inspection.

Contributions of rocks and fossils to fill up gaps in the Regional Exhibits have been made by several British geologists. Museum specimens have been received also from Foreign and Colonial Geological Surveys, and from mining companies, quarry owners and others.

The following specialists in palaeontology have rendered assistance during the year :—

Dr. E. M. Anderson, Edinburgh; Catalogue of fossils.
Mr. W. S. Bisat, Hull; Goniatites.
Mr. A. G. Davis, London; Tertiary Mollusca.
Dr. Gertrude Elles, Newnham College, Cambridge; Graptolites.
Dr. Stanley Smith, Bristol University; Corals.
Dr. L. F. Spath, Natural History Museum; Ammonites.
Dr. A. E. Trueman, Bristol University; Carboniferous Mollusca.
Dr. D. M. S. Watson, University College, London; Vertebrate fossils.

Dr. E. M. Anderson has commenced a revision of six-inch Scottish geological maps, to be issued on topographic maps based on new meridians.

Mr. R. Lunn has assisted in making clean copies of Scottish six-inch maps.

Mr. L. Richardson corrected the final proofs of ' The Wells and Springs of Herefordshire ' and is preparing a memoir on the geology of the Witney District, Oxfordshire.

Palaeontology

England and Wales.—Nearly 7,000 specimens were added to the collections during the year, and of this total 4,348 were obtained by purchase or presentation. Brief descriptions of the gifts, together with the names of the donors, are included in the List of Donations on pp. 51-56. Worthy of special mention, however, are the fossils from the Cambrian rocks presented by Dr. E. S. Cobbold, Professor A. Morley Davies and Mr. H. F. Metcalfe, as well as two rare specimens, a crinoid and a starfish, from the Upper Devonian slates of Delabole. These are both new species and were the gift of Mr. J. Setchell. We are indebted to Mr. E. W. J. Moore for another set of zonally collected Goniatites from the Lower Carboniferous and Millstone Grit, and to Miss M. S. Johnston, Lieut-Col R. H. Cunnington, Mr. H. Dixon Hewitt and Mr. W. B. Shepherd for choice material collected from various formations ranging from Silurian to Tertiary. These presentations form valuable additions to the stratigraphical collections in the Reserve and Study galleries, and some of the specimens have been placed on exhibition in the appropriate regional exhibits in the Museum.

The preparation of palaeontological specimens for the regional and stratigraphical exhibits has occupied nearly the whole time of the staff, and although considerable progress had been made before the opening of the Museum, much further work remains to be done in the mounting and labelling of specimens, particularly those already selected for the exhibit of fossils arranged in stratigraphical sequence. The work on the latter is a task of some magnitude, and may take several years to complete.

The preparation of handbooks on British Regional Geology was also undertaken by two members of the staff. One on the geology of the South of Scotland has been written by Dr. J. Pringle, and he has also made some progress with a similar volume for South Wales, to be written jointly with Mr. E. E. L. Dixon. A handbook describing the Hampshire Basin, the Isle of Wight and the Dorset Coast has been nearly completed by Mr. C. P. Chatwin, and he has another in hand on the geology of East Anglia. In connexion with the Regional handbooks, Dr. C. J. Stubblefield has selected characteristic Palaeozoic fossils suitable for illustration and spent much time in the supervision of drawings of them made by Miss O. F. Tassart and certain Survey draughtsmen. Before leaving for Edinburgh Mr. F. W. Anderson had nearly completed his manuscript for a General Guide to the Museum.

Dr. Pringle and Mr. Chatwin spent some time in the field making arrangements for the excursions that followed the Centenary Celebrations. Dr. Pringle jointly with Mr. E. E. L. Dixon prepared a descriptive guide to the South Wales and Bristol area, and later he and Mr. Dixon conducted the excursion. Mr. Chatwin wrote a similar account of the geology of the Isle of Wight and the adjacent mainland, and afterwards led the excursion with the help of Mr. Anderson.

In addition to work on Museum exhibits Dr. Stubblefield has named suites of fossils collected by Survey officers from localities in Sheets 61 (Pateley Bridge) and 23 (Cockermouth), and has supplied synoptic lists of fossils for use in the memoir on the latter district.

During the progress of their work of preparing specimens for exhibition, Messrs. S. W. Hester and W. Dewar designed a new method of mounting fossils on plaster-tablets. The method, which has been described by them in the *Museums Journal* for October 1935, is highly practical, and has been adopted whenever possible in all the display-cases.

Messrs. Hester and Dewar were both engaged for short periods on field-work. In the Embleton and Skiddaw districts, Cumberland, the former searched certain sections displaying an arenaceous facies of the Skiddaw Slates, and was successful in locating beds yielding graptolites and trilobites. He also visited a boring for water at Middleton Park, Bicester, and obtained evidence which led to the identification of the lowest beds penetrated. Mr. Dewar made large collections of fossils from the Carboniferous Limestone, Bowland Shales and Millstone Grit of the Pateley Bridge and Bradford districts in Yorkshire.

Miss M. E. Odell has given much assistance to Professor E. J. Garwood, F.R.S., who is arranging the valuable collection of Carboniferous fossils presented by him, to be placed in the Reserve

and Study galleries. Miss Odell has now completed the registration of that part of the Geological Society's Collection which has been unregistered hitherto.

On p. 20 a reference is made to the retirement of Mr. S. W. Morgan. He was attached to the staff of the Palaeontological Department for nearly 40 years, and has carried out his duties with a high standard of excellence during that long period. He was particularly expert in the art of developing fossils from hard and often intractable matrices, and many specimens in the Museum owe their beauty and perfection of detail to his manipulative skill.

During the year, in spite of the heavy calls made on the staff, 4,837 specimens were registered, and the fossils lent to specialists and other research workers exceeded 2,500.

SCOTLAND.—Over 1,400 Carboniferous fossils were added to the reference-collections in Edinburgh; these were collected by Mr. W. Manson from borings in Fifeshire, Lanarkshire and Ayrshire, and by Messrs. Eckford and McCall from various localities in Northumberland. In addition certain Jurassic and Tertiary fossils were obtained by Mr. G. V. Wilson and Mr. D. Haldane during the progress of their work in North Skye.

In the early part of the year Dr. J. Pringle identified small collections of fossils made from borings in the Kilsyth area, and with the assistance of Mr. R. Eckford completed the selection and preparation of palaeontological specimens for display in the Scottish Regional Exhibits in the Museum at South Kensington. In September Mr. F. W. Anderson, who was transferred from London, commenced work on further material from Kilsyth, and in addition he has named many of the fossils collected during the summer in Northumberland.

Research workers have made considerable use of the reference-collections during the year, and 136 specimens have been lent to approved borrowers for systematic study.

Palaeobotany

Fossil plants have been identified from localities falling within 29 of the one-inch Sheets, and for a number of outside workers and enquirers.

Much of the Palaeobotanist's time has been given to miscellaneous museum work, the chief items being concerned with the Coal Exhibit. A dioramic representation of a Coal Measures Swamp is in course of preparation, while photographs of coal mining have been obtained from various sources. The photographs are to be converted into transparencies and placed in the back of the diorama, facing the Coal Exhibit. The screens for the stratigraphical exhibit of fossils are now in an advanced stage.

Work is proceeding on the catalogue of fossil plants in the Kidston Collection.

The number of plants registered during the year was 313. Many specimens have been acquired by presentation, while purchases of calcareous nodules have been made from J. Lomax, Bolton, and of London Clay plants from A. G. Davis. Visits to the plant collections by research workers have been exceptionally numerous and the number of enquiries answered has increased considerably since the opening of the Museum in July.

Petrography

On 12th May, 1935, the Petrographic Department suffered the loss of Dr. Herbert Henry Thomas, F.R.S., who had been its head since 1st July, 1911. His death was keenly felt by the entire staff and threw a severe burden on the shoulders of those officers who had been relying on his assistance in arrangements for the opening of the Museum and the Centenary Celebrations. Until the appointment of a successor the Director, Sir John Flett, assumed control of the department. Dr. James Phemister took up duty as Petrographer in September.

During the year the staff of the department has been engaged mainly with registration and curation of the collections and in the preparation of thin sections. Much assistance was given to officers in charge of museum exhibits, and a large share was taken in the heavy clerical work and organization connected with the functions in July. In the last quarter of the year stocktaking of the sliced rock collections and arrangement and cataloguing of the unregistered collections in the basement were put in hand.

The registered collection of rock-sections has increased during the year by 669 Scottish, 113 English and Welsh, and 23 Foreign slides. Of these 40 have been presented by Sir John Flett and 5 by Mr. A. G. MacGregor. The collection now numbers :—

Scottish	31,522
English and Welsh	17,178
Irish	841
Foreign	4,129
Total	53,670

For use in the regional exhibits, and also for illustration of current work in Scotland, a total of 595 rock-specimens has been collected. A special collection of Norwegian rocks was made by Mr. W. Manson, who took part in the excursion through Southern Norway arranged by the Geologists' Association. Of his collection 148 specimens have been incorporated in the Study and Reserve rock-collection. The arrears of registration of this collection are almost overtaken and the entries now number 15,350. A card catalogue, based on locality, is in project with a view to

making this valuable collection accessible to the staff and to students, and it is hoped to proceed with the work early in the coming year.

A considerable number of enquiries from private individuals and from government departments has been dealt with, and the Petrographer took a part in demonstrations in the Museum.

Petrographic work connected with the one-inch geological maps and explanatory memoirs was largely in abeyance during the first half of the year owing to pressure of museum work. The amount of this work which is now awaiting the Petrographer and other officers is very large. The map-sheets involved are: Scotland, Sheets 123-131 (Shetland), Sheets 80 and 90 (North Skye), Sheet 61 (Arisaig), Sheet 52 (Tobermory), Sheet 30 (Glasgow), Sheet 23 (Hamilton), Sheet 14 (Ayr); England, Sheet 37 (Gosforth) and Sheet 23 (Cockermouth). The work on Sheets 23 and 14, Scotland, and on Sheet 37 (Gosforth) is well advanced, and preliminary work involved the production of negatives as follows:—Miscel-

Photography

England and Wales.—A large amount of photography, much of which was required for Museum exhibits and regional handbooks, was done by Mr. Rhodes, whose work was supplemented, as occasion required, by Mr. Radley and Mr. Benson. Indoor work involved the production of negatives as follows:—Miscellaneous negatives 634, photo-micrographs 102, and new negatives made from old plates by new apparatus 65.

In the Autumn the photographer worked in Oxfordshire (Witney district) and Leicestershire (Charnwood Forest), and later in the Lake District, where the weather was so unpropitious that a further visit is deemed necessary. During the period 250 negatives were secured.

The total number of negatives registered to date is as follows:—

English and Welsh Photographs (Series A) ...	6,680
Photo-micrographs	2,296
Miscellaneous Photographs	3,849
Total	12,825

Printing was much heavier than in 1934. Direct prints were made to the number of 4,102; outside orders accounted for 413; 1,948 were added to a 'miscellaneous' file and 102 to the Petrographer's file of photo-micrographs, the remainder being chiefly for the Survey albums or for illustrating memoirs. Enlargements numbered 292 of which 134 were large sepia-tone prints for exhibition. The latter, as well as 2,602 contact prints, were mounted. Lantern slides amounted to 502 in number: of these 243 were made in fulfilment of outside orders by the public, and 19 were replacements.

SCOTLAND.—The number of photographs taken and registered during the year is 47. The registered negatives in the Scottish Collection now number :—

Scottish Photographs, whole-plate (Series B) ...	933
Scottish Photographs, half-plate (Series C) ...	3,600
Photo-micrographs	38
	4,571

Contact-prints to the number of 390 have been prepared from Survey negatives. Of these, 91 were for outside orders, and 299 for exhibition purposes. Enlargements to the number of 75 were prepared for the exhibition screens, and for text-figure illustrations in memoirs.

Lantern-slides have been made to the number of 214, of which 70 were for outside orders, and 144 for the Scottish Loan Collection.

Chemistry

The number of analyses registered in this Department's records at the end of 1935, is as follows :—

English	369
Scottish	606
Irish	2
Welsh	55
Others	53
Total	1,085

Of these, fourteen have been completed during the year, three have been partially completed, and three are on hand awaiting analysis.

Twenty qualitative analyses have been carried out for Survey officers, and a number of enquiries from various sources have received attention. Some time has been devoted to the selection and investigation of methods suitable for the analysis of apatite rock.

The Museum

For the first six months of the year the Museum staff was solely engaged on the considerable task of preparing the exhibits for the formal opening of the building on 3rd July. In this work the Curator was assisted by Dr. W. Q. Kennedy and Mr. C. F. Davidson, who were specially concerned with the sectional exhibits on the Ground Floor illustrating the principles of geology, whilst the Assistant Curator had assigned to him the services of Messrs. H. G. Dines and V. A. Eyles for work on the economic exhibits on the Second Gallery. The displays illustrating the Regional Geology of Great Britain, in part on the Ground Floor but mainly on the First Gallery were allocated to Survey officers with special knowledge of the respective districts.

The work proceeded smoothly and, although it was found impossible to complete in detail every exhibit, sufficient was accomplished to ensure a satisfactory display when the Museum was opened.

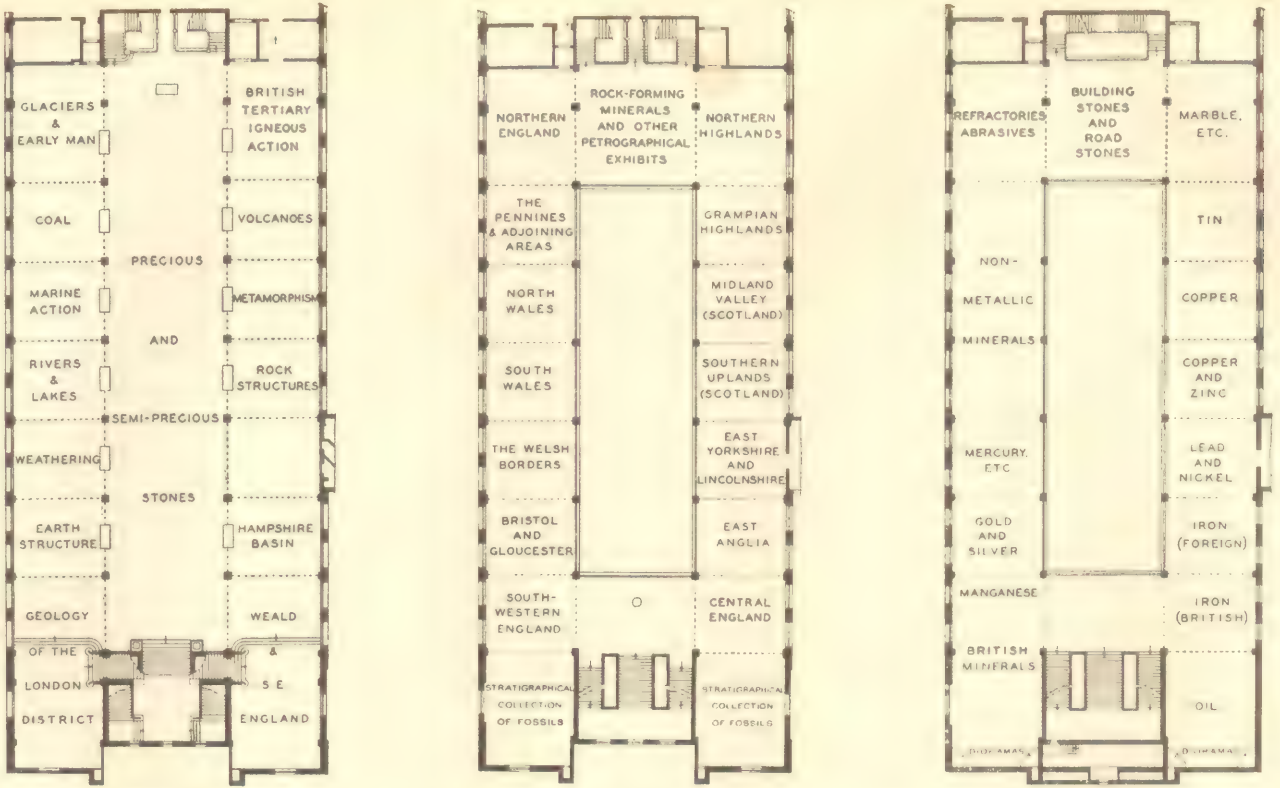
The Arrangement of the Exhibits

As foreshadowed in previous reports the occupation of the new building has been made the occasion for a complete reorganization of the exhibited collections. The extensive stratigraphical series of fossils and rocks which formed such a prominent feature of the Jermyn Street Museum, have been transferred in large measure to the Reserve and Study Gallery where they are readily available to students and research-workers, and their place taken by exhibits designed to interest the ordinary visitor and to present attractively to the student the general principles of geology, the geological history of Great Britain, and the important subjects of economic geology and mineralogy.

The arrangement is made clear from the accompanying sketch-plans (Fig. 3).

The central space of the Ground Floor (Fig. 3A) is occupied by the collection of precious and semi-precious stones which formed a prominent feature of the exhibit of minerals at Jermyn Street. They have now been separated from the other non-metallic minerals and are displayed in twenty-two specially designed, artificially lit table-cases fitted with curved glass panels to eliminate reflections. The space surrounding the well has been partitioned into bays by means of screens running between the supporting piers and the outer walls. In these bays the following subjects are now illustrated:—The General Structure and Composition of the Earth; Weathering; Marine Action: the Work of Rivers and Lakes; Glaciers and Glacial History; Volcanoes; Metamorphism; Rock-Structures; Tertiary Volcanicity in Great Britain; the Geology of London and the Thames Valley; the Hampshire Basin; the Weald and South-Eastern England; and the Geology of Coal. The exhibits comprise specimens, maps, models, photographs, and a series of eleven dioramas illustrating Cheddar Caves; Triassic Landscape: the Needles and Alum Bay; the Dawes Glacier, Alaska; Early Man in the Thames Valley; Vesuvius in Eruption; the Ancient Volcanoes of Edinburgh; the North-West Highlands; Penrhyn Slate Quarry; Portland Stone Quarry; Lulworth Cove and Stair Hole.

The First Gallery (Fig. 3B) has been allocated exclusively to British Geology as illustrated by the work of the Geological Survey. Fourteen of the eighteen districts in which the country has been divided for the purposes of illustration are dealt with here, the remaining four district exhibits being shown, as mentioned above, on the Ground Floor. These regional exhibits are, with one or two exceptions, now in order and handbooks descrip-



A. Ground Floor B. First Gallery C. Second Gallery

Fig. 3. Sketch-plans showing arrangement of exhibits in the new Geological Museum.

tive of ten of the regions have been published. The work involved in these exhibits has been considerable. It has entailed the preparation, framing and labelling of approximately 400 photographic enlargements, 24 inches by 18 inches each, the selection, arranging and labelling of approximately 14,000 specimens, and the preparation of a large number of general labels and explanatory diagrams.

A series of British fossils arranged stratigraphically is now in process of arrangement in twenty-six standard desk-cases placed at the eastern end of this gallery. Owing to the demands on the Palaeontological Staff for the preparation of the regional exhibits, it was found impossible to have this exhibit in order in time for the opening of the Museum, but steady progress is now being made towards its completion. The death of Dr. H. H. Thomas interrupted work on the collection illustrating rock-forming minerals and the common types of rocks designed for the western end of the Gallery. Work on this exhibit is now in hand, but some time must elapse before it is completed.

The Second Gallery (Fig. 3c) is devoted to Economic Geology and Mineralogy, the display being designed to illustrate the associations and geological modes of occurrence of minerals and rocks of industrial importance. The aim has been not so much to show museum specimens of minerals, but rather to show typical examples of the ores and minerals as mined with their associated country rocks. The collection contains 79 desk cases, 12 island cases, and 100 feet of illuminated wall cases, in addition to special cases for the building stones. The exhibits on the north side of the gallery, comprising the ores of tin, copper, lead, zinc, nickel, cobalt and iron are nearly in order, whilst considerable progress has been made with the collections illustrating gold, silver, platinum, etc., and the various ' non-metallic ' minerals of commercial importance. At the eastern end of the gallery four dioramas illustrating respectively the Anglo-Iranian Oilfield, the working of Northampton Iron Ore, of Cornish China Clay, and of Chalk, London Clay and Portland Cement have been installed. The western end of the gallery contains the collection of building stones.

It is gratifying to be able to report that the experience of the first six months since the date of opening seems to show that the arrangement and style of the Museum have appealed successfully to the general public and to students. The total number of visitors between 3rd July and 31st December was 158,802, as compared with an average annual total of 20,596 during the last 5 years at Jermyn Street; whilst in addition to parties of students and school classes conducted around the Museum by their own lecturers and teachers, the staff of the Geological Survey and Museum have given 80 demonstrations and lectures on the exhibits. The

appointment of a guide-lecturer to the staff has become a necessity and will shortly be made.

Public interest in the exhibits has been manifested in other ways. Articles dealing with the Museum have appeared in the Press and technical journals, whilst collectors and dealers have shown an encouraging willingness to enrich the collections with loans and gifts of valuable specimens which, otherwise, it would be difficult to acquire. Worthy of mention in this connexion are the fine series of cut zircons, including a unique royal blue stone weighing 44 carats, presented by Mr. Nicholas Ipekdjian; a beautiful set of eleven large parti-coloured crystals of tourmaline from Mesa Grande, California, presented by Mr. Adolph Tanburn; a series of rough crystals of zircon, coloured blue, presented by Messrs. Charles Mathews & Son; an extensive and valuable collection of building stones made by the late Mr. B. E. Laine-Pearson, presented by Mrs. B. E. Laine-Pearson; and a very fine necklace of mauve-coloured jade beads, loaned by Mr. C. W. Chater.

The Library

The Library has been open throughout the year and has been used to an increasing extent by the staff, students, and members of the general public. Considerable progress has now been made with the press-marking and reclassification rendered necessary by the removal, and despite the adverse conditions occasioned by this work a satisfactory public service has been maintained. Current acquisitions have been kept up-to-date, and lantern slides and photographic prints in increasing numbers have been supplied to public order.

List of Presentations during the year 1935

Alexander, G. B., Esq., B.A.—A series of Lower Carboniferous Goniatites from the Beyrichoceras Zone of Derbyshire and Staffordshire; also thirteen specimens and seven micro-slides of the Coral *Rylstonia benecompacta* Hudson, from the Carboniferous Limestones (S_2 sub-zone) of Derbyshire and Staffordshire; also two specimens of *Solenopora garwoodi* Hinde from the Lower Carboniferous at Walk Hill, south of Waterhouses. North Staffordshire.

Anderson, L. R., Esq.—Crocidolite in banded ironstone from South Africa.

Anderson, R. Esq.,—Pelé's Hair from Kilauea, Hawaii.

Allan, J. K., Esq.,—Dolomitic shale with ' fucoids ' from Assynt, Sutherland.

Anglo-Greek Magnesite Co., Ltd.—Magnesite and associated rocks and minerals from Verakini, Macedonia.

Anglo-Iranian Oil Co., Ltd.—Oil-bearing and associated rocks from Asmari Mountain, South Persia.

Arnold, Mrs. Edwin and Miss.—Collection of flint implements made by the late Edwin Lester Arnold.

Ashcroft, F. N., Esq.—Olivine crystal from Island of St. John, Red Sea.

Baker, B. A., Esq., F.G.S.—Vein and nodule celestine from Yate, Gloucestershire.

Balsillie, D., Esq., D.Sc.—Benan Conglomerate from Girvan, Ayrshire.

Bath and Portland Stone Co.—Eight-inch cube of Portland Stone.

Bellingham and Stanley, Messrs.—Calcite with a conchoidal fracture.

Bradford, W., Esq.—Fossil wood from the Island of Lemnos.

Bulman, O. M. B., Esq., Ph.D., D.I.C., F.G.S.—A specimen of

EX BIBL. UNIV. EDINBURGEN.

Capulus sp. from the Carboniferous Limestone (K_2 Beds) at Selwood Farm, Frome, Somerset.

Bosworth Smith, Mrs.—Specimens of gold ore from Southern India, buckle and disc in jade, and fruit carved in chalcedony.

Buttermere Green Slate Quarries, Ltd., Messrs.—Cut slab of tuff from Honister Quarries, Keswick.

Cement Marketing Co. Ltd., Messrs.—A series of specimens associated with Portland Cement, from Burnham, Kent.

Chile Exploration Co., Messrs.—Copper ore and associated rocks from the Chuquicamata deposit, Chile.

Cockerell, L. M., Esq.,—Sylvite from Abyssinia.

Cobbold, E. S., D.Sc., F.G.S.—A cast of the holotype of the Trilobite, *Atops reticulata* Walcott, from the Lower Cambrian of Salem, New York State.

Conolly, F., Esq.—Mica schist showing erosion by water action, from Loch Hoil, Perthshire.

Coombs, J. J., Rev.—Native Gold in quartz from Brakpan Gold Mines.

Coon, J. M., Esq.—Tourmaline, cassiterite and other Cornish minerals.

Cope, F. W., Esq., M.Sc.—Girvanella nodules from Girvanella Bed, Black Rigg Quarry, near Settle.

Cunnington, R. H., Lieutenant-Colonel.—A large series of fossils from the Jurassic, Cretaceous and Tertiary Strata of the South of England.

Curwen, E., Esq.—A specimen of *Glyphea sp.* from the Gault near Berwick, Sussex.

Davidson, C. F., Esq., B.Sc., F.R.S.E., F.G.S.—A series of Arctic shells from the Arctic Clay at Inchcoonans, Errol, Perthshire. Four rock specimens from Raasay, Inner Hebrides.

Davies, A. Morley, Esq., D.Sc., A.R.C.Sc., F.G.S.—A series of fossils and rocks from two deep borings at Calvert Station, Buckinghamshire including a figured specimen of the Liassic Brachiopod, *Orbiculoidea* aff. *holdeni* (Tate).

Davis, A. G., Esq.—Sponge-gravel from Faringdon, Wiltshire.

Devonshire Baryta Co., Messrs.—Barytes from Bridford, Christow, Devon.

Dewey, H., Esq., F.G.S.—Remains of Horse, etc. from the Middle Gravel, and of Gastropods from the Lower Loam at Barnfield Pit, Swanscombe, Kent; two specimens of *Pteroconus sp.* from the ? Middle Devonian of Bedruthan, Cornwall; also flint implements from Swanscombe and Dartford Heath, Kent and Corfe Mullen.

Dines, H. G., Esq., A.R.S.M.—Vein quartz with chlorite and ' lodestuff ', from Cornwall.

Dixon, E. E. L., Esq., B.Sc.—Chalky-Jurassic Boulder Clay from Toft, Cambridgeshire.

Dougal, J. Wilson, Esq., D.Sc.—Anorthosite from Ronival, South Harris.

Edmunds, F. H., Esq., M.A.—Granite pebble from the Lower Purbeck clay-bed, Portland, Dorset.

Edwards, J., Esq.—A series of non-marine Lamellibranchs from the Middle Coal Measures at Pooley Hall Colliery, near Tamworth, Warwickshire.

Eyles, V. A., Esq., B.Sc.—Iron and manganese ores from North Wales.

Fearnsides, Professor W. G., M.A., F.R.S., F.G.S.—Three slabs with the associated remains of *Peltura scarabaeoides* (Wahlenberg) and *Agnostus trisectus* Salter, from the Upper Dolgelly Beds of an old level in the workings of Pen-yr-allt Iron Mine near Penhyndeudreath, Merioneth: also elaterite from Castleton, Derbyshire.

Flett, Sir John S.—25 microsections of oil-shale from Scotland, 15 microsections of oil-shale from foreign localities.

Foulger, Miss.—A specimen of the Upper Chalk Lamellibranch, *Inoceramus digitatus* J. de C. Sowerby, from the Clay-with-flints of Chipstead, Surrey.

GIBSON, JOHN, ESQ.—Polished block of fossil coral from Iowa, U.S.A.

GORDON, PROFESSOR W., M.A., D.Sc.—Platiniferous ore, blende and descloizite from South Africa.

GRAINGER, J., ESQ.—A specimen of the Coral, *Aulophyllum*, from the Middle Limestone of Coverdale, Yorkshire.

GREGORY, H. H., ESQ. (Leicester Museum).—Felsitic Agglomerate from Benscliffe Wood, Leicestershire.

HARBOARD, C. R., ESQ.—Uranium Ore from Portugal.

HARRISON, SIR EDWARD R.—A series of Lamellibranchs from the Folkestone Sands of Ightham, near Sevenoaks, Kent.

HAYWOOD, MISS.—Two albums of photographs, and accompanying negatives: Yorkshire caves and potholes.

HEWITT, H. DIXON, ESQ., F.I.C., F.G.S.—A large series of fossils from the Chalk of the Thetford district, Norfolk.

HOBLEY, C.W., ESQ., C.M.G., A.M.INST.C.E., F.G.S.—A specimen of an Ammonite from the Lower Greensand, east of Atherfield Point, Isle of Wight; also a new species of *Cidaris* from the Hythe Beds near Godstone, Surrey.

HODSON, R. J., ESQ. (*per* E. E. L. Dixon, Esq., B.Sc., A.R.C.Sc., F.G.S.)—A flint dagger of Early Bronze age from Hardwick, near Cambridge.

HOLLINGWORTH, S. E., ESQ., M.A., D.Sc., F.G.S.—A series of Carboniferous Limestone fossils from Wensley Dale, Yorkshire, and autobrecciated andesite from Wastwater, Cumberland.

HOLMSIDE AND SOUTH MOOR COLLIERIES, LTD., MESSRS.—Varieties of witherite from Morrison North Pit.

HONEYWILL AND STEIN, MESSRS.—Gypsum from Canada and British Columbia.

HUDSON, R. E., ESQ., D.Sc.—Three specimens of limestone from Derbyshire and Yorkshire.

HUDSPETH, MAJOR H. M.—Sandy mudstone illustrating 'induced cleavage' from Moorfield Colliery, Accrington, Lancs.

HUMBLE OIL AND REFINING CO., MESSRS.—A series of specimens from the Hockley Salt Dome, Texas.

HUNTER, T. M., MESSRS.—Brora Coal and Brick Clay from Brora, Sutherland.

INSTITUTO DE GEOLOGIA Y PERFORAÇIONES, MONTEVIDEO.—Varved shales of Dwyka age, Uruguay.

IPEKDJIAN, NICHOLAS, ESQ.—13 cut zircons, 3 cut sapphires and some uncut zircons.

JACKSON, J. W., ESQ., D.Sc., F.G.S.—A series of Carboniferous Limestone fossils from Derbyshire, facetted stones from Pendleton, Manchester, and a specimen of clay baked by contact with intrusive dolerite from Derbyshire.

JEHU, PROF. T. J., AND CRAIG, R. M., ESQ.—Lewisian rocks from Outer Hebrides.

JOHNSTON, MISS M. S., F.G.S., F.R.G.S., F.Z.S.—A collection of fossils from various horizons, selected from her collection.

JONES, T. A., ESQ.—Lower Keuper Sandstone from the Wirral Peninsula, Cheshire.

JONES, T. H., ESQ., A.M.Inst.C.E.—A series of Sponges from the Upper Chalk from a well-shaft at Cottingham, Yorkshire.

JANITCH, CAPTAIN.—Block of 'ribbon' asbestos from Megantic County, Quebec.

KING, PROF. W. B. R., O.B.E.—Arkose from Ingleton, Yorkshire, and conglomerate from Austwick, Yorkshire.

KNIGHT, MISS S. A.—Six fossils from various localities and horizons in South-east England.

LAINE-PEARSON, MRS. B. E.—A large collection of building stones, bricks, tiles, etc. Collected by the late B. E. Laine-Pearson.

LANG, W. D., Esq., Sc.D., F.R.S.—Collection of sedimentary rocks from the Dorset Coast.

LEEDS CAVE CLUB—Collection of lantern-slides illustrating Yorkshire caves and potholes; from photographs by the late H. Wadsworth Haywood, Esq., Leeds.

LOTT AND WALNE, LTD., MESSRS.—Coombe Rock from Maiden Castle, Dorchester, Dorset.

LONDON BRICK COMPANY AND FORDERS, LTD., RESEARCH STATION.—Fossil Wood from Oxford Clay.

LANG, PROFESSOR W. H.—Fossil plants from the Old Red Sandstone at Cromarty.

MACGREGOR, A. G., Esq., M.C.—Five rock specimens and corresponding sections illustrating the St. Leonard's sill, Edinburgh.

MACGREGOR, M., Esq., D.Sc.—Nine rock specimens from the Island of Arran.

MCCALL, J., Esq.—Two Lower Lias Ammonites from Watchet, Somerset.

MCMATH, J., Esq.—Zinc Blende and Copper Pyrites from Cwm Ystwyth, Cardiganshire.

MANGANESE CORPORATION, LTD. OF SOUTH AFRICA, MESSRS.—Series of ores of manganese and the associated rocks from Mancorp Mine, Postmasburg, South Africa.

MANTLE, H. G., Esq., M.I.M.E.—Wind-facetted pebble from a coal seam at Swinnington Colliery, Ashby-de-la-Zouche; flint implements from Stoke Newington and Baker's Hole, Northfleet; also a series of specimens from the Wenlock of Walsall and Dudley.

MAGADI SODA CO., LTD., MESSRS.—Samples of trona from Lake Magadi, Kenya.

MASON, W. D., Esq.—Six pigmy implements of Tardenoisian age from Tweed Bridge, near Selkirk.

MATHEWS AND SON, MESSRS. CHAS.—Rough crystals of zircon from Siam.

METCALFE, H. F., Esq.—A suite of Lower Cambrian fossils from near West Malvern, Worcestershire.

MOORE, E. W. J., Esq., B.Sc., A.I.C.—A series of Goniatites from the Millstone Grit and Lower Carboniferous of Lancashire and Yorkshire, including many fine specimens.

MORGAN, T. G., Esq.—A slab with specimens of *Lingulella davisi* (M'Coy) from the Ffestiniog Beds of Lake Tryweryn, Merioneth.

MOYSEY, L, Esq., D.Sc.—Ironstone nodule from Shipley, Yorkshire.

NATIONAL MUSEUM OF WALES (*per* W. E. Howarth, Esq.)—Ripple marked sandstone from the Glamorgan Coast.

NATURAL SODIUM PRODUCTS, LTD., MESSRS.—Mirabilite, raw and refined.

NEAT, F. E., Esq.—Two specimens of *Meyeria magna* M'Coy from the Lower Greensand (Crackers Group) of Atherfield, Isle of Wight.

NEWCOMBE, F. P., Esq.—A specimen of *Productus* (*Dictyoclostus*) *hindi* Muir-Wood, from the Carboniferous Limestone of Thorpe Cloud, Derbyshire.

OAKES, H., Esq.—Polished block of auriferous vein-quartz from Ontario.

OAKLEY, K. P., Esq., B.Sc., F.G.S.—Specimens of Gastropods from the Lower Loam, Barnfield Pit, Swanscombe, Kent and a fragment of *Cervus browni* Dawkins from Jay Wick Sands, Clacton.

OTAVI MINEN UND EISENBAHN GESELLSCHAFT.—Copper ore and associated rocks from Tsumeb Mine, Otavi.

PAPWORTH INDUSTRIES, LTD., MESSRS.—Chalky-Jurassic Boulder Clay from Papworth Everard, Cambridgeshire.

POCOCK, R. W., Esq., D.Sc.—Amygdaloidal Basalt from Rydebrook Dingle and Porphyritic Dolerite from the Grimshill Dyke, Shropshire.

PRINGLE, J., Esq., D.Sc., F.R.S.E., F.G.S.—A specimen of *Hildoceras bifrons* (Brugiére) from the upper Lias of Whitby, Yorkshire; also a specimen of *Carbonicola pseudorobusta* Trueman, from Dalmellington Blackband Ironstone of Dalmellington, Ayrshire.

RAISTRICK, A., ESQ., M.Sc., PH.D., F.G.S.—Pieces of pottery and specimens of the vertebrate fauna from the Cave Earth of Elbolton Caves, Yorkshire.

RECKITTS, LTD., MESSRS.—Varved deposits of powdered blue glass.

REEVE, F., ESQ.—Flint knife from Surbiton Hill.

REID, ALEX., ESQ.—Nail-head spar from Cow Green Mines, Durham.

RICHEY, J. E., ESQ., D.Sc., M.C.—Nine rocks from Northern Ireland.

ROBERTSON, J. R. ESQ.—Soapstone from Ardintoul, Inverness-shire.

RUBISLAW GRANITE CO., MESSRS.—Eight-inch cube of Rubislaw granite.

SAID-RUETE, RUDOLPH, ESQ.—Wind-eroded flint from Egypt.

SANKEY, COL. SIR STUART, K.B.E., C.V.O.—Emerald in calcite and silver ores from Province of Tolima, Colombia.

SEDGWICK MUSEUM, CAMBRIDGE (*per* A. G. Brighton, Esq., M.A., F.G.S.).—A series of fossils from East Anglia from formations ranging from Cornbrash to Quaternary.

SETCHELL, J., ESQ.—Two rare specimens (a new species of Crinoid and a new species of Starfish) from the Delabole Slates of Delabole, Cornwall.

SHANKLAND, E. C., COMMANDER, R.N.—Tooth of *Elephas primigenius* Blumenbach, from the river gravel of Thames Haven, Essex.

SHEPHERD, W. B. ESQ., F.G.S.—A specimen of *Metoicoceras pontieri* Riche, from the Lower Chalk of Beachy Head, Sussex.

SHEPPARD, T., ESQ., M.Sc.—Hull Museum.—Peat dredged from submerged bed on Dogger Bank, North Sea.

SHERLOCK, R. L., ESQ., D.Sc.—Polished Sarsen from Walters Ash, High Wycombe, Buckinghamshire; also pyrite, etc. from Cae Coch, Carnarvonshire.

SLAVIK, PROFESSOR F.—Manganese ores from Czechoslovakia.

SMITH, BERNARD, ESQ., M.A., Sc.D., F.R.S.—' Teased-out ' Jurassic (? Argovian) limestone, Jungfraujoch.

SMITH, BERNARD, ESQ., M.A., Sc.D., F.R.S. and C. A. MATLEY, ESQ., D.Sc., F.G.S.—Three specimens of *Bolopora undosa* Lewis from the basal Arenig, near Amlwch, Carnarvonshire.

SMITH, B. R. C., ESQ.—Selenite from the Lower Purbeck Beds of Cottonfields Quarry, Portland.

SMITH, S., ESQ., M.A., D.Sc., F.G.S.—A topotype of *Dibunophyllum derbiense* Sibly from the Carboniferous Limestone of Monsal Dale, Derbyshire.

SMITH, S. AND W., MESSRS.—Barytes, fluorspar, etc. from Derbyshire and Yorkshire.

SPATH, L. F., ESQ., D.Sc., F.G.S.—A series of Ammonites, etc., from the Kimmeridge Clay of Dorset.

STUBBLEFIELD, C. J., ESQ., PH.D., D.I.C., A.R.C.Sc., F.G.S.—A specimen of *Productus* (*Avonia*) *bassus* Vaughan, from the Carboniferous Limestone (K Zone) and one of *Mitcheldeania gregaria* from the Lower Carboniferous (C_2) at Mitcheldean, Gloucestershire; also a series of Brachiopods and Corals from the Woolhope Limestone near Woolhope, Herefordshire.

SWEDISH IRON ORE, LTD., MESSRS.—Suites of specimens illustrating the iron deposits at Grangesberg, Sweden and at Kiirunavaara and Gellivara in Lappland.

SWINNERTON, PROF., H. H., D.Sc.—Twenty-two rock specimens from Lincolnshire, nine specimens from the Derby and Notts. Coalfield.

TANBURN, ADOLPH, ESQ.—Tourmaline crystals from Mesa Grande, California.

TAPSCOTT AND BROWNE, MESSRS.—Hopeite from Broken Hill, Rhodesia.

THOMAS, H. HAMSHAW, ESQ., M.B.E., M.A., Sc.D., F.R.S.—Forty-seven specimens of plants from the Estuarine Series of Yorkshire.

Trechmann, C. T., Esq., D.Sc.—Rhomb-porphyry boulder from Warren House Gill, Durham: Relics of the 1902 Mt. Pelée eruption from St. Pierre, Martinique.

Turner, J. S., Esq., B.Sc., F.G.S.—A series of Carboniferous fossils from the Shap and Penrith districts.

United States Potash Co., Messrs.—Sylvite, halite, and other salts with associated rocks from Carlsbad, New Mexico, U.S.A.

Walton, James, Esq.—Twenty-one specimens from the Ingletonian of Yorkshire.

Wanlockhead Mining Co., Messrs. (*per* Edinburgh Office).—Minerals of the Leadhills District, Lanarkshire.

Watkins, A. C., Esq.—Sandstone used in construction of London Docks.

Welch, F. B. A., Esq., Ph.D.—Coral Limestone from the Mendip Hills, Somerset; also a large series of fossils chiefly from the Lower and Middle Oolites of Dorset, Somerset and Gloucester, a series of Brachiopods and Corals from various horizons and localities in the Carboniferous Limestone of Somerset, and five specimens of *Gastrioceras subcrenatum* [Schlotheim MS.] C. Schmidt, from the 'Millstone Grit' near Ashwick, Somerset.

Weld, B. J., Esq.—Auriferous jacutinga from Brazil and white cassiterite from Lampi Island, Mergui.

Wheeler, Professor R. V.—Specimens illustrating the rational analysis of coals.

Wilson, G. V., Esq., B.Sc.—Minerals from the Leadhills District, Lanarkshire.

Williams, A. M., Esq.—Silica sand from Ryash, Malling, Kent.

Williams, N. T., Esq., J.P.—(Bequest), Diamond crystal in garnet.

Winbolt, S. E., Esq.—Samples of 16th Century glass, etc.

Wingfield, A. H., Esq.—Cassiterite in iron oxide from South Crofty Mine, Cornwall.

Bernard Smith,
Director.

II. DISTRICT REPORTS

(A)—ENGLAND AND WALES

1. SOUTHERN DISTRICT

HENRY DEWEY, District Geologist.	
H. G. DINES, A.R.S.M., A.M.INST.C.E.,	Senior
F. H. EDMUNDS, M.A.,	Geologists.
W. LLOYD, B.Sc.,	
S. BUCHAN, B.Sc., PH.D.,	Geologists.
F. B. A. WELCH, B.Sc., PH.D.,	
J. A. ROBBIE, B.Sc.,	

THE time of most of the Southern District staff was devoted to the Museum and only Dr. Buchan and Dr. Welch undertook normal surveying. Late in the year Mr. J. A. Robbie joined Dr. Welch to receive his field training.

Co-operation with other departments has been continued. Mr. Dines was delegated to attend at Oxford the 3rd International Congress of Soil Science and the excursions connected with it. He also attended the annual field meeting of the Soil Surveyors at Dartington, Devon, and has described a number of samples of soil for the Forest Products Research Laboratory.

Mr. Edmunds was engaged upon the arrangement of a Museum Exhibit illustrating the geological features of Central England, and in writing a Regional Handbook to that district. He has devoted some time to research for the Inland Water Survey of Great Britain, especially with regard to the catchment area of the River Nene. He served on a Joint Committee of H.M. Office of Works, the Building Research Board and the Geological Survey that is investigating the properties of building stones suitable for repairing the fabric of the Houses of Parliament.

Dr. Buchan spent some time in assisting at interviews and in replying by letter to the ever increasing number of enquiries, which during the last five years has increased from 300 in 1931 to upwards of 800 in 1935. This work involves such heavy demands upon the time of the Southern District staff that one or two men are prevented from undertaking normal field work throughout the year.

The enquiries relate for the most part to water supply for both public bodies and private individuals; but many engineering problems depending upon geology, such as tunnelling, sewage works, drainage, building sites, movements of sub-soil, have been reported on; while reserves of minerals such as oil, coal, fuller's earth, building stone and roadstone have been subjects of frequent enquiry.

Dr. Buchan has made good progress with the six-inch colour-printed geological maps in London; during 1935 five more sheets were published and thirty-one proofs sent for engraving or colour-printing to the Ordnance Survey.

A memoir on the 'Wells of London County' is in hand. Since the 'Records of London Wells' was published in 1913, over a thousand fresh records and a wealth of detail relating to chemical analyses of water, water-levels and yields have been received. The addition of this information to the material already published would make a second edition of the 'Records of London Wells' costly and unwieldy, and it has been decided to issue separate volumes giving well records of the Counties of London and of Middlesex, and to print appendices to the memoirs on the Water Supply of Essex, Surrey, Herts and Kent.

Witney District (Sheet 236)

Mr. Linsdall Richardson has been preparing for the Geological Survey his manuscripts relating to the Geology of the Witney District (Sheet 236), but it was clear that these would need amplifying, especially as regards the Pleistocene deposits; Mr. Dines was deputed to map these deposits and to take the opportunity to revise some of the boundaries of the solid formations. Before the end of the field season he had practically finished the survey of the drift deposits in parts of the valley of the Cherwell, the Evenlode, the Windrush and the Thames. Owing to the obscure nature and relationship of the older drifts it was considered necessary to attempt a correlation of the Oxford area with that of Moreton-in-Marsh, and a short tract of the Evenlode valley between Milton and Daylesford in the adjoining map is to be surveyed.

Photographs of important sections were taken by Mr. J. Rhodes.

Bridport District

Dr. F. B. A. Welch continued the primary six-inch survey of the Bridport map (Sheet 327).

He has found that extensive east and west faults of pre-Cretaceous age affect the Jurassic rocks in the tract of country between Loders and Eggardon, which in that respect resemble the 'trough faulted' area lying between Beaminster and Broadwindsor.

On the coast, west of St. Gabriel's Water, east of Charmouth, it has been proved that the Ridge Faults are of different ages, an earlier east and west fault having been displaced by one aligned north and south.

A large post-Cretaceous fault has been traced in a south-east direction from Toller Whelme to Compton Valence, a distance of seven miles. At the latter locality the Chalk Rock has been thrown against the Upper Greensand.

Large landslips, similar to those described in the 'Summary

of Progress for 1934' (p. 47), have been observed between Eggardon and Askerswell, and also in the Litton Cheney, the Coombe and the Shipton Hill areas.

Lias.—Dr. Welch, who received assistance late in the season from Mr. Robbie, mapped a wide area underlain by the Lower and the Middle Lias, but exposures were seldom seen. The Belemnite Marls with the Belemnite Stone at the top, and the Watch Ammonite Stone have been recognized in the north-west of the area. In its typical form the Junction Bed was observed only on the east and west flanks of Quarry Hill, half a mile west of North Chideock. Farther east, between Henwood Hill and Quarry Hill, the rock does not seem to occur, while in the cliff face between Eype Mouth and Thorncombe Beacon the Bed is very thin and only sporadically developed.

Fuller's Earth.—Along the coast south-west of Swyre and around Knowle Hill, north of Askerswell, the representative of the Fuller's Earth Rock—the Brachiopod Beds—has been seen. In a ploughed field at West Bay there were found great numbers of the characteristic shell *Rhynchonelloidea smithi*.

Upper Greensand.—At Gribb, north-west of Thorncombe, the Calcareous Grit differs from the normal coarse quartz grit in consisting of very fine grained white grit, containing lumps and nodules of black chert, which passes upwards into the normal coarse grained grit immediately below the Chalk.

Drift.—Dr. Welch and Mr. Robbie have found that the solid rocks are extensively masked by masses of drift deposits of local origin which vary in composition according to the rocks on which they lie. Especially is this the case in the west and the north-west of the district. The Angular Chert drift here covers both hill and valley alike.

Sevenoaks District

Lower Cretaceous Beds.—Dr. Buchan continued the primary six-inch survey of the Lower Cretaceous rocks around Dorman's Land, Chiddingstone and Penshurst in the Sevenoaks district (Sheet 287). He has found that important modifications of the lines on the Old Series one-inch map Sheet 6 are necessary.

H. Dewey.

2. WEST MIDLANDS AND CAMBRIDGE DISTRICTS

C. H. Dinham, B.A., District Geologist.
E. E. L. Dixon, B.Sc., A.R.C.Sc.,
R. L. Sherlock, D.Sc., A.R.C.Sc.,
R. W. Pocock, D.Sc., } Senior Geologists.
S. E. Hollingworth, M.A., D.Sc.,
J. H. Taylor, M.A., B.Sc., } Geologists.

IN the first half of the year, Mr. Dinham and Miss E. M. Guppy were much occupied in secretarial and cognate work, in connexion with the Opening of the new Museum and the Centenary Celebrations of the Survey. During the period of greatest pressure they received valuable assistance from Mr. T. G. Jones, of the Petrographical Department, and Mr. E. F. Bunt, of the Library staff.

Further work on Museum exhibits, in particular those of London and the Thames Valley and of East Yorkshire and Lincolnshire, was done by Dr. Sherlock during the year, and Dr. Pocock completed his share of the Welsh Borderland exhibit and memoir on the regional geology. Preparation of material for the South Wales memoir and exhibit was interrupted by the sudden death of Dr. H. H. Thomas, and in the autumn this work was taken over by Mr. Dixon, jointly with Dr. Pringle.

Field work was carried forward in both of the districts allotted to this unit. Mr. Dixon and Dr. Sherlock extended their examination farther northward in the Huntingdon Sheet (187), of which about one-third has now been revised. The primary six-inch survey, which is also the primary drift survey, of the Droitwich Sheet (182) is more than half completed. Dr. Pocock has been mapping the southern fringe of the Wyre Forest Coal-field, between Bewdley and Rock. Dr. Hollingworth, working between Ombersley and the Abberley Hills, was joined in October by Mr. Taylor, who, under his supervision, has surveyed a small area on the south edge of the Sheet.

Indoor work has included the answering of enquiries relating to water supply and other subjects. Once more, over 300 of these have been dealt with by Mr. Dinham and his staff. Progress has been made with the preparation of standards of both districts—work that had been postponed for two years in favour of Museum activities. About half of the Dudley Memoir (Sheet 167) has been written, and the Shrewsbury memoir (Sheet 152) is nearly ready for sending to press.

Cambridge District

Oxford Clay.—This formation is rarely exposed in the area surveyed, even where it is not covered by drift. The sections at Eynesbury, Gallow Hill, and several other brick pits in the St.

Neots district, are found by Dr. Sherlock to be overgrown. In spite of their being farther from the outcrop of the Cornbrash than from that of the Elsworth Rock, it seems not improbable that these clays belong to the lower 150 ft. or so of the Oxford Clay, that is, to the part which has most often been exploited for brick-making in other localities. As yet, however, their horizon cannot be exactly determined.

Corallian.—Mapping of the Elsworth Rock has been continued by Mr. Dixon. A feature of interest was the difference in character of the rock as found between Yelling, Elsworth and Hilton and as exhibited near Abbotsley. Ferruginous oolite is of constant occurrence along the first-mentioned stretch of outcrop, and most of the debris is brown in colour, whereas near Abbotsley oolite is practically wanting and the usual rock-type is a white marly limestone. The fossils throughout include abundant *Serpula* and *Exogyra nana,* but a greater variety of other forms is associated with them along the Elsworth crop.

Superficial Deposits.—The Glacial deposits consist of Older Drift, comprising Chalky Boulder Clay, locally overlying thin gravels, and some ill-defined patches of superficial gravel that are probably Newer Drift. A sheet of boulder-clay covers the greater part of the area surveyed. At St. Neots, Dr. Sherlock has obtained evidence that boulder-clay underlies the Ouse valley gravels beneath the town, while Oxford Clay emerges in the valley-bottoms of tributaries a short distance from the main river. This indicates the presence of a sub-glacial valley at St. Neots, in the approximate position of the present Ouse.

Water Supply.—In the tract mapped by Dr. Sherlock, bores for water are not often carried into the solid rocks. Even when water is found in them (the less scanty supplies being presumably derived from the Kellaways Rock) it is too saline for ordinary use, and has in the past given rise to two well-known mineral spas. One of these, at the St. Neots Paper Mills, was supplied from an old 300 ft. bore; the other lies close to the boundary between alluvium and boulder-clay, 300 yds. from Hull Bridge up the River Kym.

Potable and copious supplies are obtained from the gravels, St. Neots and Great Paxton being furnished from those of the Ouse, Great Staughton from those of the Kym valley, and Hail Weston from one of the higher-terrace gravels. Good supplies are locally obtained from older sands and gravels that lie between the Chalky Boulder Clay and the Oxford Clay. These gravels crop out about 1¼ miles south of Great Staughton, which is expecting to obtain additional water from this outcrop, and alongside the brook near Bushmead Priory. A sandy and stony base to the boulder-clay, though rarely mappable, is probably not unusual, and is important as the most promising source of local supply, successfully tapped, for example, on Meagre Farm, near Hail Weston.

In a district like this, where wells may be sunk without getting a supply, Dr. Sherlock finds them not infrequently utilised as underground storage tanks, which are replenished from roofs, brooks or ditches. Their depth has then, of course, no bearing on the question of underground sources of water. Notes of well-depths and yields, by themselves, may accordingly prove misleading unless the source of the supply is carefully specified.

West Midlands District

Carboniferous.—The red marls and Espley rocks of Dowles Valley and the country to the south are considered by Dr. Pocock to belong to the lower part of the Middle Coal Measures, and are possibly equivalent to the measures of Etruria Marl type found below the workable coals at Highley (Sheet 167). These coals are known to deteriorate southwards, and no sign of the associated grey measures has been detected in the Wyre Forest area.

The Coal Measures of Mamble, Bayton and Clows Top belong almost entirely to the Upper division. Dr. Pocock obtained several valuable records of abandoned pits, and he also watched the sinking of a new shaft at Mamble. This showed a sequence, typical for this area, of some 75 ft. of sandstone resting on measures with *Spirorbis* limestone and two workable coals.

Keuper Sandstone.—In the tract between Great Witley, Dunley and Shrawley, Dr. Hollingworth reports a greater development of breccia near the base of this group than is found to the east of the Severn. Breccias recur at intervals throughout the Sandstone, but the linking up of individual beds presents much difficulty owing to rapid lateral variation, extensive faulting and, there is reason to suspect, intraformational unconformity. Increase in the proportion of red marl, and development of brown and grey-white sandstones indicate, as usual, approach towards the top of the Sandstone.

Several newly-recognised faults, with a general northerly trend, complicate the main structural feature— a broad anticline pitching south-eastwards through Little Witley. East-and-west faults also occur, a small group of which is well exposed near Little Whitley beside the main road.

Between Great Witley and Martley a narrow strip of Keuper Sandstone, not shown on current maps, in most places separates the Keuper Marl outcrop from the eastern boundary of the Abberley Hills.

Keuper Marl.—In the lowest 300 ft. of this division are bands of relatively resistant rock, consisting of greyish-green sandstone, impure dolomitic limestone, or green or red marls. From the features which these produce to south of the Little Witley area, Dr. Hollingworth discovers the structure to be a general southerly inclination, with gentle folds pitching in the same direction; but the beds rise westward near the Abberley Hills, and towards the Severn a strong easterly component is again observable in the dip.

Working among higher beds on the other side of the river, Mr. Taylor finds that the strike of the Marl is once more brought out by a series of ridges, some of which present a definite scarp to the west. The most prominent of these runs north from Coneybury Wood, west of Tibberton, nearly to the Worcester and Birmingham Canal, beyond which it soon re-appears, rounds Smite Hill, and continues northward with decreasing importance. A belt of distinctive rocks, harder than the average marl, has been mapped half a mile to the west of Smite Hill. It includes sandy marls, and soft sandstones with rounded sand grains, together with hard red marlstone and thin green sandstone. This horizon appears to be overlain by a considerable thickness of normal clayey marls, separating it from the thin pale sandstones of 'skerry' type, interbedded with grey and white marls, that seem to have once been quarried on the crest of the ridge near Coneybury. The amount of sandstone in these last increases southwards, and they are represented on the old series map (Sheet 54 S.W.) as continuous with the sandstone of Spetchley, east of Worcester, generally regarded as more or less equivalent to the Arden Sandstone of Warwickshire.

Superficial Deposits.—Small patches of a 'boulder-clay' resting on sands have been mapped by Dr. Hollingworth west of the River Severn. In the same area he records deposits of unstratified drift up to 10 ft. thick, containing angular stones derived from the old rocks of the Malvern-Abberley ridge (?='Malvern Drift'); these are regarded as products of solifluxion processes.

Terrace features, with or without a capping of sand or gravel, are reported by Dr. Hollingworth at heights of 170-175 and 205-220 ft. Across the river, Mr. Taylor finds similar features at similar levels, and has also encountered small patches of terrace gravel at altitudes of 255 ft. and 130-135 ft. There seem further to be traces of a terrace at 105-110 ft. just above the alluvium of a tributary streamlet.

Glacial sands, with a few pebbles, occupy considerable areas at Martin Hussingtree and Fernhill Heath. Among scattered observations that bear on the Pleistocene history of the district Dr. Hollingworth notes the presence of hemispherical pockets in Keuper Marl, underlying the terrace sands mapped by Prof. T. N. George about 1½ miles from Droitwich on the Worcester Road. These pockets, which were exposed in road-widening operations, are filled with pebbly clay, and are indications of severe frost action on an old land-surface. Effects of cold conditions are also visible in the disturbed state of the upper part of the terrace-gravels, at the 175 ft. level, mapped by Prof. George at Witton, one mile distant to the north-east. Whether more than one cold period is involved is as yet uncertain.

C. H. Dinham.

3. YORKSHIRE DISTRICT

HEADQUARTERS: YORK

C. E. N. BROMEHEAD, B.A., District Geologist.
D. A. WRAY, PH.D., M.Sc., Senior Geologist.
J. V. STEPHENS, B.Sc., B.ENG.
WILFRID EDWARDS, M.A.,
G. H. MITCHELL, PH.D., M.Sc., D.I.C., } Geologists.

DURING 1935 Mr. Bromehead and Dr. Wray have been mainly occupied with work for the new Museum; Mr. Bromehead has charge of the bay devoted to the geology of East Yorkshire and Lincolnshire, Dr. Wray that for 'the Pennines and Adjacent Areas,' covering West Yorkshire, Lancashire and parts of Cheshire, Derbyshire and Nottinghamshire. The choice and arrangement of specimens, drawings, photographs, maps, etc., has been completed for both districts and the explanatory matter is in place, either printed or typewritten. Dr. Wray has completed his volume of British Regional Geology, which is passing through the press, while that on East Yorkshire and Lincolnshire is still in manuscript. Other members of the staff have assisted in the preparation of drawings and the collection of specimens.

Despite this abnormal work the output of six-inch coalfield maps has been steadily maintained; the memoirs on the Wakefield (78) and Barnsley (87) Sheets are in hand and the preparation of the one-inch maps can now be started. Some 200 economic enquiries were answered during 1935, the majority deal with water supply, but some of the most important with coal-mining. Both in Yorkshire and Nottinghamshire the structure of areas hitherto unworked has been studied and reported on to Colliery Companies who proposed to develop them.

In November Mr. Bromehead was transferred from York to London to take charge of the Southern District. Mr. T. H. Whitehead was promoted to fill his place, but illness prevented his taking up his duties at York until the end of the year. In the temporary absence of a District Geologist additional work fell on the remaining members of the staff. Dr. Wray, the Senior Geologist, was transferred to Manchester at the end of the year.

BRADFORD AND SKIPTON DISTRICTS

Millstone Grits.—An area of Millstone Grits belonging to the E Zone has been mapped by Dr. Mitchell between Middleton and Askwith-in-Wharfedale. The grits dip steadily south-eastward, forming a long dip-slope. Grits of the same age were surveyed

in the Aire valley near Kildwick. Here an important anticline runs north-eastwards through Bradley; on Farnhill Moor the outcrop of the Bradley Coal can be traced round the fold. Some of the larger faults near Cononley are mineralized and the deposit of galena in them was formerly worked on a considerable scale.

Higher beds, belonging to the H Zone, have been recognized between Ilkley and Burley, but here landslips cover large stretches on the valley side.

Around Otley and Yeadon Mr. Edwards has proved a succession from the top of the E_2 Zone to the base of the Coal Measures, amounting to about 1,500 feet of strata. The Kinderscout Grit crops out along Otley Chevin; it is underlain by the Caton Gill beds, well developed at Great Dib, Otley and overlain by the *Reticuloceras reticulatum, mut.* α marine band. The 'Middle' Grits' succession includes two thick grits with the *R. reticulatum* mut. β and late mut. β bands between them; practically no other grits are present below the Rough Rock, which is well developed.

Beds of about the same age have been mapped by Mr. Stephens on both sides of the Worth valley between Haworth and the Lancashire border. A succession from the Kinderscout Grit to the Rough Rock was established in which the following marine bands were found: *Reticuloceras reticulatum* type; three bands with various mutations of that fossil; *Gastrioceras cancellatum* and *G. crenulatum*. No marked structural features were noted, but there is much faulting.

Glacial.—On Keighley Moor Mr. Stephens finds that a lateral moraine of the ancient Airedale Glacier forms a marked feature; he also noted many overflow channels, especially around Oakworth. Gravels, apparently connected with glacial corridor lakes, have also been mapped. Dr. Mitchell has traced lateral moraines in parts of Wharfedale. Mr. Edwards, by combining official work with private investigation, has reached interesting and, in part, novel conclusions regarding the glacial history of the Vale of York; these may be published shortly.

C. N. Bromehead.

4. LANCASHIRE DISTRICT

HEADQUARTERS : MANCHESTER

W. B. WRIGHT, Sc.D., District Geologist.
T. H. WHITEHEAD, M.Sc., A.R.C.Sc., } Senior Geologists.
L. H. TONKS, M.Sc., }
R. C. B. JONES, M.C., M.Sc., Geologist.

THE One Inch (Drift edition) and the Six-Inch maps of Sheet 84 (Wigan) are now published. The Solid edition of the map is in the press and the Memoir is nearing completion. Field work has been finished in Sheet 75 (Preston) and standardization of the six-inch maps is in an advanced state.

In addition to the normal work of the office Dr. Wright has attended the meetings of the River Mersey Committee of the Water Pollution Research Board.

PRESTON DISTRICT

Triassic.—At the close of 1934 the resurvey of the Preston map (Sheet 75) was finished except for a small area about Penwortham. This area was completed by Mr. Tonks in the summer of 1935 and the six-inch and one-inch maps of the sheet are now being prepared.

In the area south of Preston the solid rocks are obscured by thick drift deposits except along the Ribble where Bunter Sandstone is to be seen in places in the river bed. Borings a short distance south of the river, at Penwortham, have revealed the unexpected presence of Keuper Marl below the drift there, and in order to separate this marl from the known outcrops of Bunter Sandstone to the north it is necessary to postulate an east-west fault through Penwortham. Farther south Keuper Marl has been proved in borings at Leyland, and although the evidence is scanty it is clear that these marls must occupy a considerable area south of Preston where they were not previously known to occur. The extent of this outcrop is of great importance because of its bearing on questions of water-supply, and the results of future borings will be of great interest.

RUNCORN DISTRICT

Revision of Sheet 97 (Runcorn) was started during the year.

Coal Measures.—Mr. Tonks commenced work on the Coal Measures south of the St. Helens Field in June. Examination of cross-measure tunnels at the collieries revealed the presence of the Carbonicola bands of the Ovalis Zone known elsewhere to lie both above and below the Arley Mine and above the Rushy Park Mine.

Bands associated with the Park and the Pigeon House groups of coals in the Modiolaris Zone were also noted. Elsewhere in the sequence, however, fossil shells were absent and the detailed correlation of the coals of this south-western part of the Lancashire field must therefore depend on other methods. The southward and westward thinning of the measures as a whole continues into this southern area, and the coal seams, though thick, tend to deteriorate in quality and to include bands of dirt and bass.

At the surface the Coal Measures are for the most part covered by drift, but important brick pits at Roughdales, south of St. Helens, at Whiston Lane Ends, and near Huyton Quarry, show interesting sections of parts of the higher measures.

Bunter.—Mr. Whitehead surveyed an area near Ellesmere Port, Ince and Helsby. The Lower Mottled Sandstone is not exposed in this area unless some non-pebbly sandstones, underlying pebbly sandstones, north-east of Ince village should be placed in this division.

The Pebble Beds are bare of drift at Ince, Elton, Thornton le Moors and Hapsford. They consist, in part, of sandstones in which pebbles, up to 3 in. in length, are numerous but not massed to form conglomerates, and, in part, of variegated sandstones in which pebbles are rare or absent. The pebbly type prevails at Ince, but both types can be seen alternating in the railway cutting near Elton.

The Upper Mottled Sandstone is exposed in numerous places at the foot of Helsby Hill and the Frodsham enscarpment.

Keuper.—The junction between the Upper Mottled and Lower Keuper Sandstones does not, in general, appear to be sharp. The lower part of the Lower Keuper Sandstone consists of relatively hard, coarse, gritty, brown-red sandstones, more violently current-bedded than those of the Upper Mottled division, alternating with softer sandstones hardly distinguishable from the latter.

The Waterstones, flaggy sandstones interbedded with purple and green shaly marls, crop out north and west of Alvanley. In the neighbourhood of Helsby Hill and Frodsham Lordship it appears impracticable to separate off any beds between these and the lower parts of the Basement Beds as " Frodsham Beds."[1]

Pleistocene and Recent.—On the completion of the Wigan Memoir Mr. Jones spent a short period mapping to the north and north-east of Warrington. The Bunter Sandstone, which occupies this area is largely drift-covered. The sand and laminated clays and silts deposited in glacial Lake Kenyon, discussed in the Wigan Memoir, are found to extend south into this ground.

[1] ' The Geology of the Neighbourhood of Chester,' (*Mem. Geol. Surv.*), 1882, pp. 7, 9.

The ' Late Glacial ' flood gravels described on the south side of Manchester,[1] where they lie at 100 ft. O.D., are found to have descended to below 25 ft. O.D. at Warrington. East of this town the edge of the terrace is marked by a fall of about 20 ft. to the present alluvium. The sands are found to extend northwards up Sankey Brook, which appears to have contributed considerable quantities of material to the terrace.

Areas of blown sand can be mapped on the surface of the terrace and wind-etched pebbles have been noted.

Boulder-clay covers most of the ground, surveyed by Mr. Whitehead, above the level of the marshes; and a scattering of erratics almost to the highest points of Helsby and Woodhouse Hills shows that ice enveloped the whole area. Large boulders of Scottish and Lake District rocks are not uncommon; and in brick pits near Ellesmere Port boulders of sandstone resembling the Cefn-y-Fedw Sandstone of North Wales and of sandy Carboniferous Limestone (fossiliferous), like that of North Wales, were found with granite and other rocks of Scottish and Lake District types.

North-east of Alvanley there are patches of sand and gravel that seem, in part at least, to underlie the boulder-clay. A deposit of brown sand forms a rude terrace to the brook in the valley between Helsby and Woodhouse Hills and spreads out as a fan at its mouth. It seems clear that this sand overlies the boulder-clay and it evidently originated as an outwash from the high ground in post-Glacial times. Its relation to the marsh-clay of Helsby Marsh could not be determined.

Peaty sand north-east of Hapsford, with a terrace-like relation to the marsh clay, may be a southerly representative of the Shirdley Hill Sand.[2]

Dr. Wright was engaged in surveying the area to the north of Anderton and Wincham in the south-eastern part of the district. There is very little exposure of the underlying Keuper Marl and the drifts show a tripartite subdivision with middle sands. The patchy and often sandy nature of the upper boulder-clay make it difficult to trace and this difficulty is in places enhanced by subsidence due to the removal of salt, which renders the distribution of the drift very irregular. Pick Mere and Budworth Mere are natural subsidence tarns and are older than the flashes of Northwich which result from pumping. They are connected by an alluvium-filled valley which is part of the same subsidence.

The peat bogs lying to the north, namely Sink Moss and

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[1] Jones, O. T., ' The Origin of the Manchester Plain,' *Journ. Manch. Geogr. Soc.*, vols. xxxix-xl, 1922-4, pp. 89-133, and ' The Geology of Manchester,' (*Mem. Geol. Surv.*), 1931, p. 185.

[2] See A. Strahan, *op. cit.*, p. 30.

Whitley Reed, are almost entirely reclaimed and under cultivation. Some of the older farmers around took part in the original work of reclamation. The soil in the more central portions is a sandy peat and the sand element increases towards the margins.

There is almost everywhere in this area a thin skin of sandy loam up to a foot or more in thickness. It spreads over Glacial sand and boulder-clay alike and is probably quite late in date of formation, owing its origin to the same source as the sandy element in the peat soils. It is probably a wind-borne accretion like the Shirdley Hill Sand of Lancashire. Where it occurs the soils are definitely different from the substratum.

W. B. WRIGHT.

5. FOREST OF DEAN

T. Eastwood, A.R.C.Sc., District Geologist.
F. M. Trotter, D.Sc., Senior Geologist.
W. C. C. Rose, M.Sc.,
K. C. Dunham, Ph.D., Sc.D. } Geologists.

WITH the exception of Dr. Dunham, who joined in October, the members of the above unit, in conjunction with Dr. Hollingworth, were engaged on the preparation of the map and memoir of the Gosforth area of Cumberland. The map is now printing and the memoir almost ready for the press. Some progress was also made in preparing the maps of Sheet 23 (Cockermouth) for publication, but the memoir on that region remains to be written. This indoor work, together with some in connexion with the Museum, occupied the greater part of the year; consequently the field season was of short duration.

In the Forest of Dean (Sheet 233, Monmouth), Dr. Trotter continued his work on the coalfield; Mr. Rose was engaged on its north-western border around Staunton, and Dr. Dunham, after a short period of training, was allotted an area straddling the Wye to the south of Lower Redbrook.

Detailed mapping revealed several interesting structures: Dr. Dunham reports that Lower Redbrook is situated on a gentle east and west syncline, while to the east, just beyond Newland, a sharp, north-plunging syncline appears to be terminated to the south by a north-west—south-east fault. These structures affect the Old Red Sandstone.

Farther to the north-east, Mr. Rose found that the north-western border of the main Forest of Dean basin is complicated by a subsidiary syncline ranging from north-west to south-east and pitching in the latter direction. Between Staunton and the Wye the Lower Carboniferous rocks on the south-western flank of this syncline are highly inclined; elsewhere the dip seldom exceeds 10°. The Coal Measures, which are unconformable to the Lower Carboniferous, also participate in this folding, but the synclinal fold in them is not so well defined as it is in the lower strata.

Dr. Trotter found that three associated structures, which all die out southward, affect the western part of the coalfield. From west to east these are:—a shallow syncline, an anticline, and a zone of fracture 400 to 500 yds. in width. The broken belt trends north-north-west through Speech House Road Station and consists of numerous faults up to 60 ft. displacement which, with few exceptions, are downthrows to the west.

The unconformable nature of the base of the Coal Measures may be demonstrated near Carterspiece (2¼ miles N.N.E. of

Coleford, in the synclinal area last mentioned). There the Coal Measures rest on the Lower Dolomite on the west side of a north to south fault, while on its east side they rest on the Drybrook Sandstone.

Old Red Sandstone.—The Quartz Conglomerate, described in a previous *Summary*, has again proved useful in mapping, for it frequently gives rise to crags and sharp features amidst sandstones with subordinate marls or mudstones with a smoother topography. Most of the pebbles occur in two bands, but some are scattered in the intervening strata and also in beds above and below the two main bands.

Carboniferous Limestone Series.—In the area mapped hitherto the junction between the sandstones, provisionally classed as Old Red Sandstone, and the Lower Limestone Shales has appeared to be sharp, but Dr. Dunham has found about 20 ft. of passage beds between the two formations. These occur between Valley House and Lower Redbrook and consist of sandy limestones interbedded with soft, red, green and brown sandstones.

In the numerous old workings for iron-ore along the outcrop of the Crease Limestone for two miles south of Coleford, Dr. Trotter observed that much of the rock has changed from the normal white crinoidal limestone into grey, coarse granular dolomite. The lower beds of the Whitehead Limestone are dolomitic china stones and are known as ' The Lid ' or ' Lidstone ' because of their position above the ore-bearing Crease Limestone.

In the Drybrook Sandstone near Milkwall a limestone, about 40 ft. thick, is largely oolitic; in places it contains layers of sand.

Coal Measures.—In the area investigated by Mr. Rose, the base of the Coal Measures transgresses from the Drybrook Sandstone (at Redinghorne) to the Lower Dolomite (at English Bicknor). The lower measures hereabouts consist of a gritty sandstone near the base, followed by thin-bedded sandstones and clays up to the Coleford High Delf. Some of these measures are well exposed in Marian's Brickyard at the fork of the roads a mile south-east of Staunton. Here the Lower Trenchard Coal is represented by a thin ' smut ', but neither it nor the Upper Trenchard has been located elsewhere in this region. Numerous small pits and levels around Hillersland, Joyford and Berry Hill have served to exploit the Coleford High Delf, and some of them are still used.

Dr. Trotter reports the following sequence of measures in the Coleford-Bream area.

	Ft.
No Coal Seam	1 to 1½
Measures, mostly shale	50 to 60
Brazilly Seam (including partings)	up to 3
Measures, mostly sandstone	230 to 320
Yorkley Seam	1½ to 3
Measures, mostly sandstone	150 to 160
Whittington Seam...	0 to 3½
Measures, mostly sandstone	150 to 190
Coleford High Delf Seam, generally	3½ to 4½
Measures, mostly sandstone	90 to 100
Upper Trenchard Seam	0 to 2½
Measures, sandstone, grit and shale	60 to 80
Lower Trenchard Seam, generally	2 to 3
Mudstone	8 to 12

In the western part of the field the Lower and the Upper Trenchard seams are seldom both workable in the same area. For instance, the Upper Trenchard is absent at Coleford and Bream, but is workable in the intervening ground about Ellwood, whereas the Lower Trenchard thereabouts (*i.e.* about Milkwall) is of inferior quality and divided by partings, though it is of value farther north and south.

The Coleford High Delf, the most important seam in the coalfield, usually ranges between 3 ft. and 5½ft. in thickness, though it occasionally reaches 24 ft. As a 3½-ft. to 4½-ft. seam it is actively exploited on the western side of the basin from north to south by the Lydney and Crump Meadow, the Cannop and the Princess Royal collieries.

North of Drybrook[1] the Whittington Seam is too thin for working, but has been mined to a limited extent to the south of that place.

The Yorkley is thin and of variable quality in the north-western part of the coalfield, but thickens southwards and is reported to be of good quality in the Bream Parkend area.

The sandstones given in the sequence above are of Pennant type and some of them have been extensively quarried for building and ornamental stones. Quarries working for the latter are still in operation.

T. EASTWOOD.

[1] Situated 1¼ miles north-north-west of Bream, and not to be confused with the village of Drybrook near Ruardean.

6. NORTHUMBERLAND AND DURHAM DISTRICT

HEADQUARTERS : NEWCASTLE-ON-TYNE

R. G. CARRUTHERS, District Geologist.
G. A. BURNETT, B.Sc., A. FOWLER, M.A., B.Sc. } Senior Geologists.
W. ANDERSON, M.Sc., Geologist.

FIELD-WORK during the 1935 season was carried on in three widely separated areas. High up the North Tyne, near the Border, Mr. Fowler was engaged on Lower Carboniferous ground in Sheet 7, where the revision was all but completed. In the country north-west of Newcastle, in the southern half of Sheet 14, Mr. Burnett was at work on the Upper Limestone Group and Millstone Grit between Great Whittington and Dissington; he also gathered much mining information required for the completion of various 6-in. Coalfield maps in Sheet 15, originally started by Mr. Eyles. Much farther south, in County Durham, Mr. Anderson began the revision of Coal Measures around Tanfield, Beamish and Urpeth, an extension of work he had done many years ago between Gateshead and Rowlands Gill.

Cementstone Group.— A small inlier of these strata, brought up by folding and faulting, was noticed by Mr. Fowler in the streams around Oakenshawburn farmstead. Inclinations of 22° or more predominate, and the exposures, though good in themselves, are far from continuous. They all appear to lie high in the Group, for amongst the usual barren cement-limestones and shales, a few crinoidal bands are seen, one with brachiopods (*Spirifer*, etc.), in addition.

Fell Sandstone.—West of the Oakenshawburn stream-sections are coarse felspathic sandstones and chocolate marls, of typical Fell Sandstone aspect. More massive sandstones show through the peaty hill-tops around Dinmont Lairs, and, along with greenish and purple mottled marls, in the Grains Burn just above Willow Bog, where they dip 30° to north-north-west.

Scremerston Coal Group.— Following on above these Fell sandstones, representatives of the Scremerston Group are seen in the stream immediately west of Buck Fell. Amongst the sandstones and shales at least one 6-in. bed of shaly coal is to be seen. More shales, with a thin ironstone rib resting on a rather coarse, brownish sandstone rich in brachiopods and lamellibranchs, are seen half-a-mile upstream from the main road along the Grains Burn valley.

Better sections occur along the Border, in the Kershope Burn, where they belong to a faulted-in trough extending from Oakenshaw Burn through Black Knowe and Lazy Knowe. Amongst strata of normal Scremerston type, including one or two thin coals, are a few thin crinoidal limestones, sometimes with brachiopoda and fenestellids; it will be remembered that the Group has a far more marine facies in the North Tyne region than it has in the type areas round Berwick-on-Tweed.

The best sections of all lie some miles farther east, in the Lewis Burn. From the fault 500 yds. south of the Forks upstream to Low Long House, there are ample exposures of no less than 750 ft. of strata, all of which have been carefully examined and measured. Amongst the great variety of sediments seen, there are many fossiliferous horizons with brachiopods, lamellibranchs and bryozoa (*Stenopora sp.*), along with gastropods and *Spirorbis*. Several thin coals, up to 18 in. thick, are present and some of them (notably the Lewisburn Kiln and House Coals) have been wrought, although a general inclination of 20° or more has prevented any extensive operations. The chief marine strata appear above the House Coal, where at least four crinoidal limestones are seen, from 2 ft. 4 in. up to 4 ft. thick. The general position of this Lewisburn sequence is certainly low down in the Scremerston Group, for it starts 150 ft. or so below the Plashetts Coal; but no junction with the Fell Sandstone can be made out, and exact correlations with other areas are not yet possible.

Upper Limestone Group and Millstone Grit.—In the south-west corner of Sheet 14, west of Newcastle, Mr. Burnett has noted further outcrops, near Little Whittington, of the Uggo grit referred to in last year's *Summary* as lying just below the Little Limestone Coal. The Coal itself is, as usual, in two seams some 25 ft. apart, the lower one workable. A good way south of this the Oakwood Coal has been got, and about 250 yds. north-east of the drift-mouth of the old Halton Colliery an indifferent exposure of the overlying Oakwood Limestone can still be seen. Farther east a regularly ascending sequence persists for some miles, as far as the small quarries in Millstone Grit south of Eachwick House and to the south-west of Loudside. These must be at, or near, the base of the Grit, for a boring at Eachwick House found greenish marl, shales and thin limestones with Producti under 8 fathoms of grit. One or two other core-borings, all for water, have been of great service in mapping this drift-covered country.

Coal Measures.—The Brockwell Coal, marking the base of Middle or Productive Measures, has its typical development in County Durham; it is therefore a matter of congratulation that in a coalfield where confusion of seam-nomenclature is all too common, investigation shows that the Brockwell of Northumberland is

identical with its namesake south of the Tyne. Recent sinkings at Choppington have found the underlying Victoria Seam in workable state.

In the ground examined by Mr. Anderson in Durham (Tanfield, Beamish and Urpeth) the outcropping seams lie in the upper half of the Productive Measures. Five of them are between 4 and 8 ft. thick, and, as might be expected, are practically wrought out. Recourse is now had to lower seams, and in particular the Busty Coal, in two divisions no more than an inch apart at Beamish and Urpeth, but 35 ft. at Tantoby. Surface exposures are practically confined to quarries in the Hutton and Shield Row Posts (sandstones) but abundant mining information has led to extensive additions to the published maps. The seam-nomenclature has caused a good deal of trouble through the use of the same set of names for different sequences in the various royalties.

Three considerable pre-Glacial valleys, the existence of which was hitherto unsuspected, have been traced across the area. All are, of course, now completely filled in with glacial deposits, but they have notably modified the local coal outcrops. They run (1) from South Moor almost to Waldridge, (2) from Harperly Hall eastwards through Beamish Hall, and (3) from Marley Hill south-eastwards. The last-named channel is in places 200 ft. deep, and crossing the upper Team valley near Urpeth, proceeds towards Pelton Fell.

During the past year an important sinking was completed about 300 yds. south-east of the present working shaft at Kibblesworth Colliery. This began above the Five Quarter Coal, the second highest in the district, and went right through to the lowest seam, the Brockwell. Full collections of plants and shells were made as the work proceeded and this material is now being examined.

Glacial.—Stretches of sand and gravel, occasionally ' kettle-holed ', are to be seen around Dissington and Darras Hall, in the Millstone Grit country north-west of Newcastle. They form a southerly extension of the Ponteland-Prestwick Carr sands, and are shut off from the Tyne by a belt of high ground reaching from Harlow Hill to High Callerton; one or two ' dry channels ' cut this ridge, notably the one south of Dissington Old Hall. Other sand and gravel mounds are found in Mr. Anderson's ground in County Durham, between Hedley and Waldridge; possibly they represent ice-front deposits belonging to a prolonged halt in the final retreat. West of this belt the Stanley-Pelton ridge is notched at five levels by overflow channels which carried water southwards from the Team valley.

R. G. CARRUTHERS.

(B).—SCOTLAND

1. RENFREWSHIRE

J. E. Richey, M.C., Sc.D., District Geologist.
V. A. Eyles, B.Sc., Senior Geologist.
W. Q. Kennedy, D.Sc., Geologist.

AFTER a lapse of some years the revision of one-inch Sheet 30 was resumed by the above-named geologists on their return from museum work in London. A considerable part of the Calciferous Sandstone lava-plateau south of the Clyde estuary was remapped. Mr. Eyles spent only a short time in the field in the Largs district. Dr. Kennedy practically completed the re-examination of the country around Kilmacolm, Bridge of Weir and Port Glasgow.

Calciferous Sandstone Volcanic Rocks.—To the east of Largs, in the south-west corner of the Sheet, the lava sequence commences with a series of flows of olivine-rich, microporphyritic basalt which overlies a thick basal ash and contains intercalations of ash and ashy and marly sandstone. The assemblage is succeeded by a flow of mugearite. A little to the north-east, just east of the Noddsdale Water, a succession of Markle basalts and mugearites is faulted against the basal olivine-rich flows.

A number of small dykes and sills, presumably of Calciferous Sandstone age and varying in composition from basic to acid types, cuts the lavas of this district.

In the Port Glasgow—Langbank district the lavas are faulted against the underlying sediments, which in this neighbourhood exhibit a well-marked interbanding of Upper Old Red Sandstone and Cementstone facies. The bounding fault runs in an east-west direction and, immediately to the west of Devol Glen, passes for a short distance through the volcanic rocks. The base of the volcanic sequence is there exposed and the basal flows consist of a succession of mugearites resting on a thick ashy marl. With this exposure as a starting point, a general sequence can be worked out for the entire district eastwards to Bridge of Weir.

The lava succession has been subdivided as follows :—

Upper Group (olivine-rich types)		Olivine-rich, microporphyritic or non-porphyritic basalts.
Lower Group (mainly feldspathic types)	Upper	Alternations of mugearite and Dunsapie basalts with subordinate Markles. The basal flow is a thick Craiglockhart basalt.
	Lower	Alternations of Markle basalts and mugearites with occasional Dunsapie basalts.

Composite flows with an upper porphyritic member and a lower mugearitic portion, are rather common and, in the absence of continuous exposures in such faulted country, tend to complicate the mapping.

North-south dykes of mugearite and Markle basalt cut the lavas.

Permo-Carboniferous Dykes.—Quartz-dolerite dykes, with a general east-west or more rarely north-east trend and up to 75 ft. in width, cut both the lavas and the underlying sediments. They can be proved to be definitely later than both east-west and north-west to south-east faulting. In two cases they could be traced up to but failed to cross north-east faults; it was impossible, however, to determine whether or not they were themselves faulted.

Glacial.—The country is well glaciated and striated surfaces are abundant. These indicate two main directions of ice movement, an earlier one from west-north-west to east-south-east and a later from approximately N. 10° W. to S. 10° E. These two directions of movement are possibly to be correlated with the presence, in the Greenock—Port Glasgow district, of two distinct boulder-clays, an underlying greyish-red, relatively stiff clay, and an upper, bright-red, sandy boulder-clay characterized by abundant pebbles and boulders of green-schist and quartzite.

J. E. Richey.

2. WEST HIGHLAND DISTRICT

J. E. Richey, M.C., Sc.D., District Geologist.
J. B. Simpson, D.Sc., Senior Geologist.

THE primary survey of the Highlands was continued by the above-named geologists in one-inch Sheet 61 (Arisaig and Mallaig). Dr. Simpson was engaged for three months in the mountainous country around Loch Eilt and in the Ardnish peninsula eastwards of the Sound of Arisaig, along the southern margin of the area. Dr. Richey began the mapping of the Morar district farther north.

The programme was restricted, as several members of the unit, including Dr. Richey, were engaged in the final arrangement of their exhibits for the new Museum and, during July, in matters connected with the Centenary Celebrations of the Survey.

Moine Schists and Injection-Gneisses.—In the Morar district a stratigraphical sequence has been established in the most westerly known schists of the Moine Series which, fortunately, lack the pegmatitic injection that forms injection-gneisses farther east. Three main lithological groups in descending order of age are given below, together with their subgroups. True bedding is almost everywhere recognizable and is steeply inclined or vertical.

1. False-bedded psammitic schists ; interbedded with group 2 at base.
   - b. Massive pink and feldspathic psammitic schists, often pebbly, with frequent false bedding.
   - a. Thinly bedded pale or white psammitic schists with abundant false bedding, with occasional beds of semipelitic schist.

2. Semipelitic and pelitic schists ; interbedded with group 1 at base.
   - c. Semipelitic and finely striped schists with thin layers of calc-silicate schist and thin seams of magnetite-zoisite rock.
   - b. Garnetiferous mica-schist.
   - a. Finely striped and semipelitic schists.

3. False-bedded pinkish feldspathic psammitic schists.

The order of age is proved in the psammitic groups (1 and 3) by means of the abundant and well-preserved false bedding. Further, as indicated, the three lithological groups are united in a single stratigraphical series by the occurrence of interbedding along their mutual junctions as well as along the junctions of the various parts into which groups 2 and 3 are subdivided.

The tract of country occupied by the above succession is about 7 miles in width as measured across the strike of the beds, which runs approximately north and south. The highest and most westerly group (3) has been traced along the coastal belt from near Mallaig southwards towards the Sound of Arisaig. Its maximum breadth of outcrop is slightly less than 4 miles. The outcrop of the second group (2) varies between 1 and 2½ miles in width. The stratigraphically lowest group (1) is less massive.

The lower half of group 3 (subgroup a), in which false bedding is strikingly developed, forms the starting-point for working out the succession. Almost every bed shows false bedding and indicates the order of deposition. Without exception the beds are younger towards the west. Further, the average thickness of individual beds is only about 9 inches. Exposure is so good that it is possible to say without hesitation that repetition of beds by folding does not occur. Isoclinal folding has been seen nowhere. The thickness, therefore, of this subgroup is considerable, and must amount to many thousands of feet.

If the present position of the true bedding is due to tilting of the strata without any marked torsional movement, then it may be concluded from observation that the original dip of the false bedding was predominantly towards the north, either slightly east of north or, more rarely, slightly west of north. The sediment-bearing currents, therefore, must have travelled almost invariably towards the north.

Dr. Simpson considers that groups 3 and 2 of the Morar district correspond in lithological characters with the two most westerly groups previously recognized in Ardnamurchan (Sheet 52), namely, the massive pebbly schist group west of Glenborrodale and the Carna pelitic group.[1] No exact counterpart of group 1 was noted in Ardnamurchan. It may, however, correspond with the most westerly part of the Ben Laga psammitic group, which lies east of the Carna pelitic group.

The Ardnish peninsula is occupied by psammitic schist with subordinate pelitic bands, which corresponds in character with the Ben Laga psammitic group. This similarity is emphasized by the occurrence of cariously-weathering epidote bands in the continuation of these schists to the north of the Ardnish peninsula, where good examples may be collected on the northern shore of Loch nan Uamh at the mouth of the Beasdale Burn. Similar bands are present in the Ben Laga group of Sheet 52 towards its western margin.

The complicated zone of folding previously described from the area between Ben Resipol and Beinn Gàire (Sheet 52)[2] continues northwards to Loch Eilt in a well-marked fold which closes to the south. A belt of garnetiferous pelitic schist forms an outer

[1] 'Summary of Progress for 1921' (*Mem. Geol. Surv.*), 1922, pp.89-90.

[2] 'Summary of Progress for 1934, Part I' (*Mem. Geol. Surv.*), 1935, p. 65.

member of this fold. The belt has been traced from the shores of Loch Eilt immediately west of Sgùrr na Paite south-westwards along Beinn Coire nan Gall to Druim Fiaclach. With a change of strike the belt continues in a south-easterly direction along the ridge of Druim Fiaclach as far as Beinn Mhic Cèdidh. Here it turns north-east again, and with minor complications continues back to the head of Loch Eilt. Within this arcuate outcrop and conforming with it in strike come a mixed pelitic and psammitic assemblage and a central belt of psammitic schist.

Minor Intrusions. — In the districts surveyed last year occasional sheets of basic and ultrabasic rocks belonging to the appinite suite have been noted. The intrusions follow the steeply inclined bedding or foliation planes of the schists, and are thus dyke-like in form. They are cut by camptonite dykes.

Small bosses of quartz-dolerite similar to those recorded in various parts of Sheet 52 occur on Eilean nan Trom on the southern side of the Ardnish peninsula and, farther north, to the south of the western end of Loch Morar, north of Sgùrr an Albanaich. At the former locality baking of the country rock around the boss is pronounced.

At Eilean nan Trom a camptonite dyke cuts and chills against the quartz-dolerite. Other camptonite dykes with east-west and west-north-west trends have been mapped on the shores of Loch nan Uamh and along the coast south of Morar railway station.

In the Morar district Tertiary dykes of olivine-dolerite are abundant. They trend slightly west of north, and represent a southwardly divergence of a portion of the north-west dyke-swarm of Central Skye. Farther south, in Sheet 52, northwardly running dykes have been already recognized as a divergence from the Mull swarm. The Morar dykes complete the evidence of the existence of a north-south belt of dykes which connects the Skye and Mull plutonic centres.[1]

In the Morar district several instances of Tertiary dykes cutting camptonites have been observed.

J. E. Richey.

[1] *See* J. E. Richey, 'Tertiary Ring Structure in Britain,' *Trans. Geol. Soc. Glasgow* vol xix, part I, 1932, p. 52.

3. SKYE

G. V. Wilson, B.Sc., District Geologist.
T. Robertson, B.Sc., Ph.D., A.Inst.M.M., } Senior
D. Haldane, B.Sc., } Geologists.
J. K. Allan, M.A., B.Sc., } Geologists.
J. Knox, B.Sc., }

THE primary geological survey of Skye was continued during the past field season by the above-named members of the staff. Mr. Wilson was engaged on the ground in the vicinity of Portree and Dr. Robertson in the Bracadale area, where he worked northwards from the ground surveyed some 35 years ago by Dr. A. Harker. Messrs. Haldane and Knox continued from where they left off last year in Trotternish, and after completing the northern part Mr. Haldane moved into Waternish (Vaternish on the One-inch Map). Mr. Allan commenced work in the Duirinish peninsula which lies to the west of Dunvegan and contains the spectacular, terraced hills of Plateau Basalts known as Macleod's Tables.

Jurassic Sediments.—A small area of Jurassic rocks of Upper Estuarine age, not previously recorded, has been noted by Mr. Allan in the extreme west of Duirinish. Between Oisgill and Moonan bays the sea-cliffs are formed by two thick sills of olivine-dolerite and an associated thin suite of shelly limestones and shales. The sills have very irregular margins and the sediments often occur as lenticles and pockets between them, as, for instance, between Oisgill Bay and the headland of Eist, where they have given rise to a well-marked ledge along the cliff. Farther east, at Camas nan Sithean, sediments overlying the upper sill are seen dipping gently below the lavas of Waterstein Head. A preliminary examination of the beds, which are accessible only in a few places, has yielded such estuarine forms as *Cyrena* and *Viviparus*.

In the north end of Trotternish Mr. Haldane finds that more than three-quarters of the area in which the Jurassic rocks occur is occupied by a large sheet of intrusive dolerite, and that except at Kilmaluag and Score Bays the sediments are usually restricted to lenticles and tongues of material caught up in the igneous mass. In many instances the more argillaceous rocks have been "burnt" to a hard, greyish-blue, splintery substance in which the calcined remains of a few small shells can be detected. Towards the south, in the ground mapped by Messrs. Wilson and Knox, the proportion of sedimentary to igneous material gradually increases.

Tertiary Sediments.—An interesting discovery of a bed containing recognizable leaf impressions was made at a point situated

near the 600-ft. contour about 600 yds. due west of the south end of Loch Fada, 2½ miles north of Portree. The locality occurs near the base of the lavas, on the steep grassy slope which overlooks the south-western corner of the peaty flat of Lòn Coire na h-Airidh. The outcrop is much obscured by a thin grass-covered layer of surface scree and soil, and until further excavations have been made it is not possible to give the details of the section nor the height of the bed above the base of the lava-sequence. It may be stated, however, that several exposures of fossiliferous materials have been noted, and that the full thickness of the sediments is in the region of thirty feet. The leaf impressions have been obtained from a band of dark grey, fine-grained, shaly material with ill-defined bedding, which under the microscope is found to consist largely of a dark brown indeterminate clayey groundmass in which are embedded numerous grains of quartz, felspar, glauconite and black carbonaceous matter. Among other types of sediment noticed at this locality mention may be made of well-bedded, black carbonacous shale, coaly matter and greenish, mottled palagonite tuff.

The specimens collected have been submitted to Professor T. Johnson, who has recognized the following forms:—*Magnolia, Fagus, Quercus, Platanus, Cercidiphyllum, "Graminites", Sequoia* and *Ginkgo*. Of these *Ginkgo* is by far the most common, and its frequency here is especially noteworthy when compared with its rarity in the material collected from the Ardtun Beds[1] in the Ross of Mull. It is also interesting to note that *Magnolia* is not recorded from that locality.

As regards the position of this bed in the lava sequence and its possible lateral extent, it may be worth mentioning that sediments containing coaly matter have long been known to occur at about the same horizon in other parts of the island. In one or two instances efforts have even been made to work the coal, as, for example, at Camas Ban, half a mile south-east of Portree, at Abhuinn Gremiscaig, 1 mile north-north-west of Loch Cuithir, at Lower Halistra, Waternish, and in the river Conon 250 yds. above Conon Bridge, near Uig. A further locality at which coal has been noted is that described by A. Geikie[2] at An Ceannich, 5 miles south-south-west of Dunvegan Head.

Bedded Ashes.—At many places along the coast between Àrd Beag and Bay Mr. Haldane has noted the presence of a bed of volcanic agglomerate up to 50 ft. or more in thickness. It occurs at the base of the lava-sequence, weathers with an ochreous crust and contains numerous fragments of basalt, volcanic bombs and occasional fragments of fossil wood which exhibit good cellular

[1] 'The Tertiary and Post-Tertiary Geology of Mull, Loch Aline and Oban' (*Mem. Geol. Surv.*), 1924, p. 74.

[2] Geikie, A., 'The Tertiary Basalt Plateaux of North-Western Europe,' *Quart. Journ. Geol. Soc.*, vol. lii, 1896, p. 341.

structure. Microscopic examination of the material shows that the matrix consists essentially of glassy palagonite tuff with porphyritic crystals of olivine, ophitic augite and microliths of felspar, and further that it is practically identical with the green, mottled palagonite tuff already mentioned as being associated with the leaf-bearing sediments near Portree.

Tertiary Lavas.—No section has yet been mapped which shows the actual unconformable junction of the lavas with the underlying Jurassic sediments. In the main this is due to the large amount of landslipping that has taken place along the boundary of the two formations. To the south of Loch Fada, however, the great landslip, which has been traced down the eastern side of Trotternish for a distance of over 15 miles, dies out and at the same time the lavas appear to the east capping the cliffs above Prince Charlie's Cave and southward to Portree.

The examination of the lavas shows that the flows average 20 ft. or so in thickness, and consist of a lower slaggy portion, a central hard band, and an upper slaggy portion which often shows a reddened top, and in some instances is overlain by a thin layer of red bole. Occasionally the lower few inches are packed with thin pipe amygdales, and individual pipes may extend upwards for 6 or 7 feet into the hard central portion of the flow.

In composition the lower flows consist in the main of olivine-basalts in which the olivine is readily visible to the naked eye and sometimes constitutes a large percentage of the rock. As the sequence is traced south-westwards from the neighbourhood of Portree some of the higher flows are found to consist of fine-grained, rather splinty, black basalt, which often weathers with a greyish crust and possesses mugearitic affinities. Still farther south-west, in the Bracadale area, this type becomes more prevalent, and typical mugearites occur, together with big felspar basalts, thus giving an association of rock types comparable to that noticed in Central Mull.[1] In addition, rocks with trachytic characters have also been noted, as, for instance, on the side of the road above Allt Mor, two miles north-east of Struan, and again in a stream about half a mile north of Struan.

Intrusive Igneous Rocks.—In the northern part of Trotternish Mr. Haldane finds that the great sill, which farther south forms the Kilt Rock, extends right round the headland and in many places gives rise to sea-cliffs over 300 ft. high. Along this rocky barrier, which in many places is formed of vertical columns, the only gaps are at Kilmuluag and Duntulm bays.

By far the greater number of the dykes noted have directions varying between N.W. and N.N.W. Of those with other trends mention may be made of an east-north-east dyke on the shore of

[1] 'The Tertiary and Post-Tertiary Geology of Mull, Loch Aline and Oban' (*Mem. Geol. Surv.*), 1924, p. 125.

Loch Bracadale about 700 yds. south-east of Colbost Point and a north-north-east dyke seen on the west side of the Varragill River 4¼ miles south of Portree.

In the Bracadale area it was noticed that dykes of coarse-grained gabbroid and trachytic types were found either cutting, or in close vicinity to, the respective areas in which the big felspar basalts and trachytic lavas occur. Near Ullinish in the same district three instances of composite dykes were met with. In each case the centre of the dyke is filled with basaltic agglomerate while the walls consist of fine-grained basalt. The agglomeratic portions vary from a few inches to 19 ft. in width, and in one instance this type of material has been traced for a distance of over 200 yds.

An interesting group of vertical intrusions occurs along the south-west shore of Waternish. The first is to be seen traversing the cliffs about three-quarters of a mile north-west of Lower Halistra. It is about 100 yds. across, exhibits a vertical junction with the bedded basalts on the north, and on the three exposed sides shows good horizontal columns perpendicular to its margin. The other examples occur one mile and three miles respectively farther south-east. The true significance of these intrusions has not yet been made out, but the fact that they are found piercing the lowest lavas and are orientated along a north-west line suggests that they may be feeders connected with a large fissure running parallel to the coast-line.

G. V. Wilson.

III. SECTIONAL REPORTS

1. PALAEONTOLOGICAL DEPARTMENT

In London

J. Pringle, D.Sc., Palaeontologist (District Geologist)

C. P. Chatwin, M.Sc., Assistant-Palaeontologist (Senior Geologist)

C. J. Stubblefield, Ph.D., A.R.C.Sc., Geologist

In Edinburgh

F. W. Anderson, M.Sc., Geologist

A. England and Wales

OVER the greater part of the year the members of the staff were actively employed in the selection and preparation of the fossils required for the display in the Regional Exhibits in the new Museum. There is therefore little to add to the report of the work in the Department, given by the Director on pp. 42-44.

Dr. Stubblefield reports that some well-preserved Lower Cambrian fossils from the Malvern district which were submitted to him for naming by Mr. H. F. Metcalfe, proved to be of considerable interest. Although some of the specimens were previously known Malvern species, the collection included the brachiopod *Micromitra* (*Paterina*) *rhodesi* Cobbold, hitherto recorded only from the earliest fossiliferous rocks of Shropshire. The specimens formed the basis of a useful presentation by Mr. Metcalfe to the Survey Collections.

Another presentation, by Dr. C. A. Matley and Dr. Bernard Smith, F.R.S., enabled Dr. Stubblefield to determine the presence of the supposed Cyclostomatous Polyzoon, *Bolopora undosa* H. P. Lewis, in the Arenig Grit overlying the Sarn Granite in the Lleyn peninsula. The occurrence of this organism is of considerable stratigraphical importance since it places the pre-Arenig age of the intrusion beyond question.

A further record of interest is his naming of specimens of *Gastrioceras subcrenatum* [Schlotheim MS.] C. Schmidt. These were presented by Dr. F. B. A. Welch, who collected them from the so-called Millstone Grit of Ashwick, Somerset.

Much of the material collected during the year awaits examination, but amongst the specimens obtained by Mr. Hester from the Skiddaw Slates is a well-preserved trilobite (*Placoparia*) which may repay further examination.

B. Scotland

The series of fossil plants of Tertiary age, collected by Mr. G. V. Wilson at Lon Coira na L-Airidh, Loch Fada, Skye, is a discovery of unusual interest. A preliminary examination of the specimens has been carried out by Professor T. Johnson, and, from his report summarized on p. 82, it appears that *Ginkgo* is the dominant plant in this flora.

Mr. R. Eckford has discovered a new locality for *Holoptychius* in the Upper Old Red Sandstone of the South of Scotland, having found scales of this fish in the Hexpath Quarry, near Greenlaw, Berwickshire.

J. Pringle.

2. PALAEOBOTANICAL WORK

IDENTIFICATIONS have been made of fossil plants from English One-inch Sheets Nos. 8 (Elsdon), 12 (Shopford), 20 (Durham), 23 (Cockermouth), 30 (Appleby), 35 (Whitby), 39 (Kendal), 44 (Scalby), 54 (Scarborough), 68 (Clitheroe), 78 (Wakefield), 84 (Wigan), 141 (Loughborough), 152 (Shrewsbury), 167 (Dudley), 182 (Droitwich), 184 (Warwick), 203 (Bedford), 264 (Bristol), 290 (Deal), 327 (Bridport), and 343 (Swanage) and from One-inch Scottish Sheets Nos. 14 (Ayr), 22 (Kilmarnock), 23 (Lanark), 31 (Airdrie), 45 (Oban), 94 (Cromarty) and 103 (Golspie). Miscellaneous identifications have been made of specimens assigned to various Museum exhibits, and for outside workers and inquirers, mainly employed in Schools, Museums and Universities.

The registration of plant specimens is complete except for the registration anew of the fossils which were formerly exhibited in the galleries of the Jermyn Street Museum, a task which is in hand. A catalogue of the Kidston Collection of fossil plants modified from that formerly made is in course of preparation. Loans of specimens to research workers includes those to Dr. R. Florin (Stockholm), Professor H. S. Holden (Nottingham), Dr. E. Dix (London), Dr. M. Benson (Hertford) and Miss E. L. Hendricks (London). Photographs of fossil plants and of coal mining and copies of Museum labels have been lent to or provided for various lecturers and teachers on request. The plant collections have been examined by research workers on many occasions during the year. The visitors were Dr. R. G. Absalom (Glasgow), Mr. W. R. Barker (Barnsley), Dr. M. Calder (Glasgow), Dr. M. Czeczott (Warsaw), Professor M. Hirmer (Münich), Professor H. S. Holden (Nottingham), Mr. L. R. Moore (Bristol), Professor Julius Pia (Vienna), Professor A. Renier (Brussels), Dr. H. H. Thomas (Cambridge), Professor J. Walton (Glasgow), Mr. W. D. Ware (Swansea), and Mr. R. Wood (Liverpool). The Minister for Mines, Capt. H. F. C. Crookshank, M.P., paid a visit to the Museum in October. The production of coalfield maps and memoirs was described to him by Mr. T. Eastwood, and the Coal Exhibit demonstrated by Dr. Crookall.

Miscellaneous Museum work has claimed considerable time. A dioramic reconstruction of a coal-forest is in preparation, and photographs of coal-mining, to be displayed as illuminated transparencies, have been obtained from Major H. Mitcheson, Baddesley Collieries Ltd., Atherstone; the Manager of the Bestwood Coal and Iron Co. Ltd., Bestwood Colliery, near Nottingham; C. J. Gregory, Esq., Messrs. Mavor and Coulson, Broad St., Glasgow;

W. R. Morton, Esq., Sun Buildings, Newcastle-on-Tyne, and H. W. Hughes, Esq., Dudley. A series of generalised vertical sections of the Coal Measures in the chief British coalfields has been prepared and will soon be exhibited. Diagrams illustrating the classification of coals have been drawn up.

Work has proceeded on the screens which accompany the Stratigraphical Exhibit of fossils on the first gallery. Many identifications of fossil plants have been made for the various Regional Exhibits and plates of plants provided for screens. Plates have also been made for inclusion in the Sanquhar Memoir and three handbooks of the British Regional Geology (South Wales, Northern England and Central England).

Proof reading has included that of the Bristol and Gloucester Regional Handbook, the sections dealing with plants in various other handbooks passing through the press, Summary of Progress, etc. Assistance was given with the preparation of a General Guide to the Museum.

Presentations of fossil plants have been made by Mr. G. B. A. Alexander, Miss Mary Johnston, Professor W. H. Lang, the London Brick Company, Mr. C. W. Mason, Dr. C. J. Stubblefield, Dr. H. Hamshaw Thomas and Mr. J. Selwyn Turner, while Professor W. Gothan (Berlin) has presented a suite of German brown coals and Professor R. V. Wheeler (Sheffield) specimens illustrating the Rational Analysis of coals.

Enquiries, especially with regard to coal, have increased considerably with the opening of the new Museum. The number of miscellaneous identifications of fossil plants indicates an increasing interest in palaeobotany by amateur workers.

Drawings based on figures published in R. Crookall's ' Coal Measure Plants ' were reproduced by Drs. J. G. C. Anderson and A. Lamont in their account of ' The Geology of the Glasgow District from its Quarries ', in the Quarry Managers' Journal, vol. 18, 1935.

The following specimens and microscope slides in the Survey collections have been figured, described or mentioned during the year:

In Report of The British Association for The Advancement of Science, 1934 (Aberdeen).

Halle's New Technique for the Study of Incrusted Plant Remains on Primary Rocks,

By Dr. M. Benson, F.L.S.

Telangium, etc. Palaebotanical Slides Nos. P.B. 525-540, p. 388.

In the New Phytologist, Vol. XXXIV, 1935.

The New Evidence of Isospory in Palaeozoic Seed Plants,

By Dr. M. Benson, F.L.S.

Calathiops (Schuetzia) bennieana, Halle's Slide No. 3464, p. 93.
Whittleseya elegans *Newb.*, Halle's Slide No. 558, text-figs. IIIa, b, p. 95; Halle's Slide 360, figs. IV, a, b, p. 95.

The Ovular Apparatus of Sphenopteridium affine *and* bifidum *and of* Diplopteridium (Sphenopteridium) teilianum (*Walton*).

By Dr. M. Benson, F.L.S.

Calathiops (Telangium) affine (*L. & H.*), Kidston Coll. No. 627, text-fig. I, pp. 234, 236.
Calathiops (Telangium) bifidum (*L. & H.*), Kidston Coll. No. 637, text-fig. 2, p. 235; pl; vi, fig. 4; pl. v, fig. 3; Kidston Coll. No. 721, p. 238; Kidston Coll. No. 718, p. 238.
Calathiops (Telangium) bifidum (*L. & H.*), Halle's Slide No. 3461, pl. vi, fig. 5, p. 239; No. 534, text-fig. 4, p. 240.

In Geol. Surv. British Regional Geology: Northern England.

By T. Eastwood, A.R.C.Sc.

Neuropteris heterophylla *Brongt*, Kidston Coll. No. 3319, pl. iv, fig. A.
Mariopteris muricata (*Schl.*), Kidston Coll. No. 4604, pl. iv, fig. B.
Alethopteris lonchitica (*Schl.*), Kidston Coll. No. 1959, pl. iv, fig. C.
Linopteris munsteri (*Eichw.*), Kidston Coll. No. 215, pl. iv, fig. E.
Alethopteris serli (*Brongt.*), Kidston Coll. No. 241, pl. iv, fig. F.

R. Crookall.

3. PETROGRAPHICAL WORK

DURING the early part of the year the work of the Department was concerned largely with the preparation of labels for Museum exhibits and with keeping registration abreast of the demand for material for display in the Museum. Dr. Thomas, shortly before his death, laid out in the first gallery an attractive exhibit showing a model restoration of Stonehenge, made to scale and built of the original materials. Accompanying the model are (i) a map indicating the source of the stones foreign to Wiltshire and the probable route by which they were conveyed, and (ii) photographs and a ground-plan showing the present condition of Stonehenge.

Mr. J. H. Taylor has in preparation an elementary exhibit of the common rock-forming minerals.

In the latter part of the year the normal work in connexion with maps and memoirs has been resumed. The petrographer has provided names and short descriptions for 130 sliced rocks recently added to the collection and has in hand the description of the igneous rocks of Sheet 23 (Hamilton) and the preparation of the handbook on the Northern Highlands in the British Regional Geology Series. He is also editing the petrographical chapters of Sheet 37 (Gosforth). He has supplied to the Scottish Mountaineering Club a short summary of the geology of the Southern Highlands for their forthcoming guide-book. Dr. Hollingworth and Mr. Rose have in hand the petrographic description of Sheet 23 (Cockermouth).

Reports on 22 tested roadstones have been furnished to the National Physical Laboratory, and a report on the definition of quartz to the Board of Trade. Assistance has been given to Mr. B. W. Anderson in determination of the refractive indices of certain spinels. Replies have been made to many private individuals on a variety of subjects. Enquiries from the field officers have been concerned mainly with the identification of rocks.

Much time has been spent during the last quarter of the year on curation of the collections. With the assistance of Mr. A. G. MacGregor, Mr. G. E. Andrews and Mr. Eckford, stocktaking of the Scottish rock-sections has been undertaken. The latest registered number in the series was 31,522 at the end of the year. The slides then in the cabinet or known to be in the keeping of responsible persons total 31,437. Of the remaining 85 numbers, 53 are blank for various reasons which have been determined. The slides corresponding to the remaining 32 numbers have not been traced. All but 5 can be replaced from the original rock-specimens. An arrangement is now in operation whereby the present location of any rock-section is at once available. Stocktaking of the Scottish sliced rocks is in progress.

A scheme has been drawn up for card-cataloguing the Study and Reserve rock-collection, which now numbers over 15,000 specimens, including about 4,000 samples of foreign rocks. The card-catalogue, when completed, will make this valuable collection readily accessible.

Progress has been made with a systematic arrangement of the rock-collection at present stored in the basement. Dr. K. C. Dunham has now arranged the Geological Society collection of rocks in readiness for cataloguing. Other collections made by Survey officers and presented by private individuals are being dealt with.

Scotland

Mr. A. G. MacGregor has taken over general supervising duties in relation to rock-cutting, rock-sections, petrographical apparatus, and registration and storage of rock-specimens in Scotland. He has written the petrological sections for the Midland Valley ' Regional Geology ' and has contributed accounts of the igneous geology of various areas in Midlothian and East Lothian to the Centenary Excursion Guide (Edinburgh). As a result of enquiries relating to vitrified forts Mr. MacGregor has prepared a detailed petrographical report on the fused and semi-fused rocks from six Scottish vitrified forts.

Examination of thin sections in connexion with current work has been carried out by Mr. Wilson and Dr. Robertson (Shetland and Skye), by Mr. MacGregor (Sheets 52 and 61), and by Dr. Kennedy (Sheets 15 and 52). Dr. Kennedy has in hand the description of the Tertiary dykes of Sheet 14 (Ayr) for the sheet memoir.

J. Phemister.

4. CHEMICAL WORK

MOST of the quantitative chemical analyses completed during the year, of which a selection is given below, were carried out to meet the demand for a series of analyses of typical clays of various ages.

982. *Anthophyllite-cordierite-gneiss.* Gneiss of Lizard Complex. Quarry, ¼ mile north of the mill (west bank of stream), Treleare Vean (= S. of Polkernogo). Lizard Memoir, p. 39. Six-inch map, Cornwall, 81 N.W.E. Slice No. E 17043.

990. *Chlorite-epidote-schist.* Band enclosing shear lenticles of amphibolite. Shore at Limebury Point, Rickham Common, Salcombe Estuary. Six-inch map, Devon, 136 S.E. Slice No. E 17032.

989. *Albite-epidote-amphibolite.* Shear lenticle in chlorite-epidote-schist. Limebury Point, Rickham Common, Salcombe Estuary. Six-inch map, Devon, 136 S.E. Slice No. E 17024.

986. *London Clay* (*blue bed*). 40 ft. from surface. Freshly exposed face in pit, Worcester Park Brick Co., Worcester Park. Six-inch map, Surrey, 13 S.W.

987. *Oxford Clay* (*praecordatum zone*). Clay bed *in situ.* Jordan Cliff, near Weymouth (½ way along cliff, and fifteen feet above foot of cliff). Six-inch map, Dorset, 53 N.E.

992. *Oxford Clay* (*bottom blue bed*). Clay bed *in situ.* Brickyard at Chickerell, near Weymouth. Six-inch map, Dorset, 53 S.W.

993. *Weald Clay* (*top yellow bed*). 10 ft. from surface. Working face due E. of shaft. Dorking Brick Co., North Holmwood. Six-inch map, Surrey, 33 N.E.

985. *Weald Clay* (*underlying blue bed*). 18 ft. from surface. Working face due E. of shaft. Dorking Brick Co., North Holmwood. Six-inch map, Surrey, 33 N.E.

984. *Gault.* Sample from well sinking, 10 ft. from surface. Cottenham Waterworks New Well, ½ mile S.S.W. of S. end of Cottenham Village. Six-inch map, Cambridgeshire, 34 S.W.E.

991. *Kimmeridge Clay* (*virgatosphinctoides zone*). Clay bed *in situ* (11 ft. from surface, near kilns). Hill's Brickyard, Swindon, Wilts. One-inch map, 34 S.E.

(For detailed analyses see Table on opposite page).

With the exception of Lab. No. 982, all the samples contain organic matter; the figures for ferric and ferrous oxides must therefore be regarded as approximations.

Lab. Nos.	982	990	989	986	987
SiO_2	65.70	35.89	47.86	53.26	50.47
Al_2O_3	14.24	21.09	17.01	17.05	17.24
Fe_2O_3	1.51	4.69*	2.60*	4.72*	1.76*
FeO	6.37	10.32*	6.05*	2.02*	4.07*
MgO	4.89	8.89	9.42	3.39	1.94
CaO	2.39	10.32	9.56	1.60	4.61
Na_2O	1.96	0.70	2.84	0.30	0.62
K_2O	0.27	0.06	0.17	3.20	3.02
$H_2O > 105°$ ...	1.60	5.41	2.75	5.35	4.56
$H_2O < 105°$ ...	0.13	0.24	0.25	5.26	3.11
TiO_2	0.94	1.53	1.05	0.95	0.83
P_2O_5	0.17	0.10	0.05	0.14	0.17
MnO	0.09	0.25	0.21	0.03	0.04
CO_2	0.00?	0.00?	0.00?	1.40	5.48
SO_3	—	—	—	0.23	0.21
FeS_2	—	—	—	0.43	1.08
Cr_2O_3	0.01	0.04	0.03	0.02	0.01
BaO	0.02	—	—	0.02	0.00?
C	—	0.29	0.07	0.33	0.53
Totals	100.29	99.82	99.92	99.70	99.75
Analysed by				C. O. HARVEY.	

* See note in text.

Lab. Nos.	992	993	985	984	991
SiO_2	60.29	66.08	60.93	39.44	66.38
Al_2O_3	16.73	15.73	18.02	15.88	12.55
Fe_2O_3	2.02*	5.29*	3.15*	4.26*	2.20*
FeO	1.92*	0.29*	2.99*	0.91*	0.92*
MgO	1.48	0.83	1.10	1.61	0.93
CaO	0.65	0.37	0.67	13.90	1.95
Na_2O	0.87	0.37	0.40	0.36	0.51
K_2O	2.75	1.97	2.21	2.59	2.25
$H_2O > 105°$ ...	4.29	4.98	5.73	5.31	3.78
$H_2O < 105°$ ...	2.61	2.84	2.58	3.98	3.22
TiO_2	0.92	1.27	1.17	0.71	0.78
P_2O_5	0.06	0.05	0.07	0.03	0.07
MnO	0.03	0.06	0.07	0.04	0.01
CO_2	0.37	0.07	0.20	10.66	0.68
SO_3	0.57	—	0.00?	0.08	0.98
FeS_2	3.04	0.04	0.54	0.00?	1.88
Fe_7S_8	0.00?	—	—	—	0.00?
Cr_2O_3	0.01	0.01	0.01	0.01	0.01
BaO	0.03	0.04	0.04	0.02	0.03
Li_2O	—	—	—	0.06	—
C	1.06	0.18	0.50	0.40	0.62
Totals	99.70	100.47	100.38	100.25	99.75
Analysed by	C. O. HARVEY.				

* See note in text.

Some account will now be given of work carried out in connexion with the examination of a sample of apatite rock. Details of this analysis will be published at a later date.

The complete analysis of a phosphate- and fluorine-bearing rock of this nature presents considerable difficulties, mainly due to the fact that the ordinary group separation of the metals is completely disorganised in the presence of a preponderating amount of phosphate.

The usual methods of dealing with this difficulty involve preliminary removal of the phosphate as phosphomolybdate or as zirconium phosphate. Another type of method, which involves adding a sufficient amount of an iron or aluminium salt to deal with the phosphate (Lassieur, *Ann. Chim. anal.*, 1934, *16*, 197) can hardly be applied to highly phosphatic rocks, owing to the unmanageable bulk of the precipitate and the difficulty of obtaining an accurate figure of alumina.

Consideration of the various methods led to the conclusion that the present problem called for special treatment, and it was decided to work out a scheme of analysis based on a preliminary removal of the lime as sulphate (Mellor, 'Treatise on Quantitative Inorganic Analysis,' 1913, p. 606).

The details of the scheme of analysis, which is a combination of established methods, but is original in some respects, are somewhat involved, and, for present purposes, the methods employed will only be described in very brief outline.

Main Analysis.—After destruction of silicates and removal of fluoride, the barium, strontium, and calcium were removed as sulphates in aqueous alcoholic medium, and the metals of the iron group were precipitated as phosphates in acetic acid-acetate solution.

Magnesium and traces of calcium were recovered from the filtrate as phosphates.

Separation of iron and titanium from aluminium and phosphate was effected by precipitations with sodium hydroxide, and the aluminium was finally separated from the phosphate by means of 8-hydroxyquinoline (Lundell and Knowles, *U.S. Bureau of Standards J. of Research, 3,* 1929, p. 91) and weighed as Al_2O_3.

Analysis by the method of a synthetic mixture of known composition gave satisfactory results.

Silica and Fluorine.—Neither the classical method of Berzelius, nor the recent method of Hoffman and Lundell (*U.S. Bureau of Standards J. of Research*, 3, 1929, p. 581) can be directly applied to the determination of fluorine and silica in phosphate rock. Reynolds and Jacob (*Ind. Eng. Chem.*, 1931, *3*, p. 366, Analytical Edition) have found that, unless special precautions are taken, the recovery of fluorine may, in some cases, be as low as 50 per cent. of the true value. They describe a modification of the

Hoffmann and Lundell method which is applicable to phosphate rock, but which does not entirely eliminate the tendency of the results to be low. However, as the method of Reynolds and Jacob appeared to be the best available, it was used, with such modifications as would allow of the determination of silica in the residues from the florine determination.

The method involves removal of silica with zinc nitrate followed by ammoniacal zinc oxide, the fluorine being finally determined as lead chlorofluoride.

Other Constituents.—These were determined by the usual methods, modified where necessary to suit the particular circumstances.

C. O. HARVEY.

IV. MUSEUM OF PRACTICAL GEOLOGY

THE Museum was opened to the public on 3rd July. From that date until the end of the year the number of visitors was 158,802; of these 55,944 were Sunday visitors. Eighty demonstrations have been given by members of the staff to parties from colleges, schools, scientific societies and institutions, the total attendances at these being 1,794.

During the year the time of the Museum Staff has been almost entirely occupied with the preparation, arrangement and display of the exhibits in the new building. Prior to the opening, the Curator and Assistant-Curator had assigned to them the services of Dr. W. Q. Kennedy and Mr. C. F. Davidson for work on the Ground Floor exhibits, and Messrs. V. A. Eyles and H. G. Dines for work on the economic collections on the Second Floor Gallery. Messrs. Kennedy, Eyles and Dines resumed their normal Survey duties in July, Mr. Davidson being retained for permanent service in the Museum. In October an additional officer, Mr. A. J. Butler, was appointed for Museum work.

The sectional exhibits on the Ground Floor illustrating geological principles and processes are now in order and have been supplemented by a large number of photographs of such subjects as earthquakes, desert scenery, volcanoes, glaciers, etc., obtained in many cases by the kindness of Dominion and foreign surveys and institutions. A considerable amount of work has been done in the arrangement and labelling of large and striking specimens in the island cases, and four additional dioramas in illustration of these exhibits have been delivered and installed in their cases, thus bringing the number shown on this floor to eleven. A large model of Central Mull (scale 6 inches to 1 mile) has now been placed in the bay dealing with the Tertiary Volcanic Province, and models of the Weald, the Isle of Purbeck and the Thames Valley near Goring have been renovated and put on exhibition.

The regional exhibits on the First Floor Gallery are now, with one or two exceptions, in order. They have been arranged by Survey officers and the curation and development of the displays now devolves on the Museum staff. Messrs. Davidson and Butler have already done a certain amount of this work and it will be possible to increase the rate of progress when the subordinate staff, at present being re-organised, is brought up to full strength.

Steady progress has been made with the economic and mineral exhibits during the year. Four dioramas have been installed and, with the delivery of the internally lit wall-cases designed for the eastern end of the Gallery, H.M. Office of Works completed the initial programme of furniture for the Museum. During the six

months prior to the opening, work was pressed forward in all sections to bring them into preliminary order for public display. Although this was accomplished the result has been that in many sections the work is unfinished and much still remains to be done. Twelve cases are now in process of arrangement to show the valuable topographical collections of British Minerals. A large number of specimens acquired from mines in operation have been installed in the exhibits of metallic ores, and photographs and descriptive labels have been prepared for the building stone exhibit. The programme of printing labels for the collections has been steadily advanced, upwards of 7,000 labels having been delivered during the year. The registration of current acquisitions has been kept up to date, 1,711 entries have been made in the mineral inventory and 1,300 of the 3,000 specimens of the Laine-Pearson Collection of building stones have been registered.

The additions to the Library have been maintained; they comprise 139 volumes of independent works, 251 reprints, 2,598 volumes and parts of serials, and 115 maps. There were supplied to public order 504 photographic prints and 313 lantern slides.

The large attendances in the Museum have been accompanied by a notable increase in the numbers of readers in the Library, and also in the number of enquiries addressed to and answered by the Museum Staff.

The following publications by members of the staff have appeared during the year:—'The New Museum of Practical Geology', by the Curator, *Museums Journal*, 1935, vol. 35, No. 4, pp. 113-120; 'Marginal and Contact Phenomena of the Dorback Granite', by Frederick Walker and C. F. Davidson, *Geol. Mag.*, 1935, vol. lxxii, pp. 50-63; 'The Tertiary Geology of Raasay, Inner Hebrides,' by C. F. Davidson, *Trans. Roy. Soc. Ed.*, 1935, vol. lviii, part II, pp. 375-407. Dr. Hallimond contributed to the Conference of Empire Surveyors a paper on Surveying with the Magnetic Variometer, which is now in the press.

W. F. P. McLintock.

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